

# JoysMaker User Manual

## 版本更新

时间	主要内容
2013-01-15	✓ 初始版本

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## 1 Mechanics build guide

### 1.0 What you'll need



#### Time needed:

In total, for most people it takes between 6 and 20 hours to complete the assembly of a machine.



#### Tools needed:

1. Hex keys (1,5 and 2.0mm)
2. Using the included 2.0mm hex-screwdriver saves an awful lot of time compared to an L-shaped hex-wrench!
3. Adjustable wrench or large size pliers
4. Consider also a cordless lithium-ion screwdriver (e.g. Bosch IXO) with a 2.0mm hex bit.

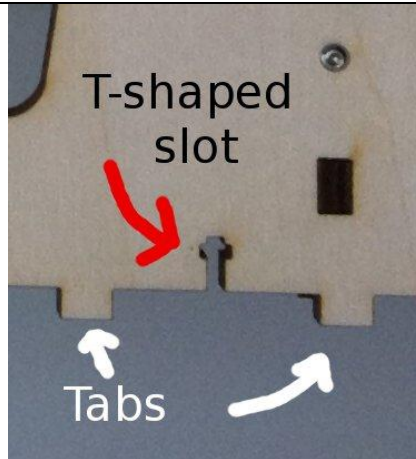
An 3Djoy kit comes with many packs. See the page for your batch to check its contents. There should be more nuts and bolts in the packs than you will need, so don't worry if you have a few left!

### 1.1 Basic design concepts

#### Metric

The design is almost completely metric (using millimeter and meters). Another system for physical dimensions is imperial (inches and feet). The nuts and bolts used are mostly M3 - they have a 3 millimeter diameter thread.

#### T-Slots and tabs:



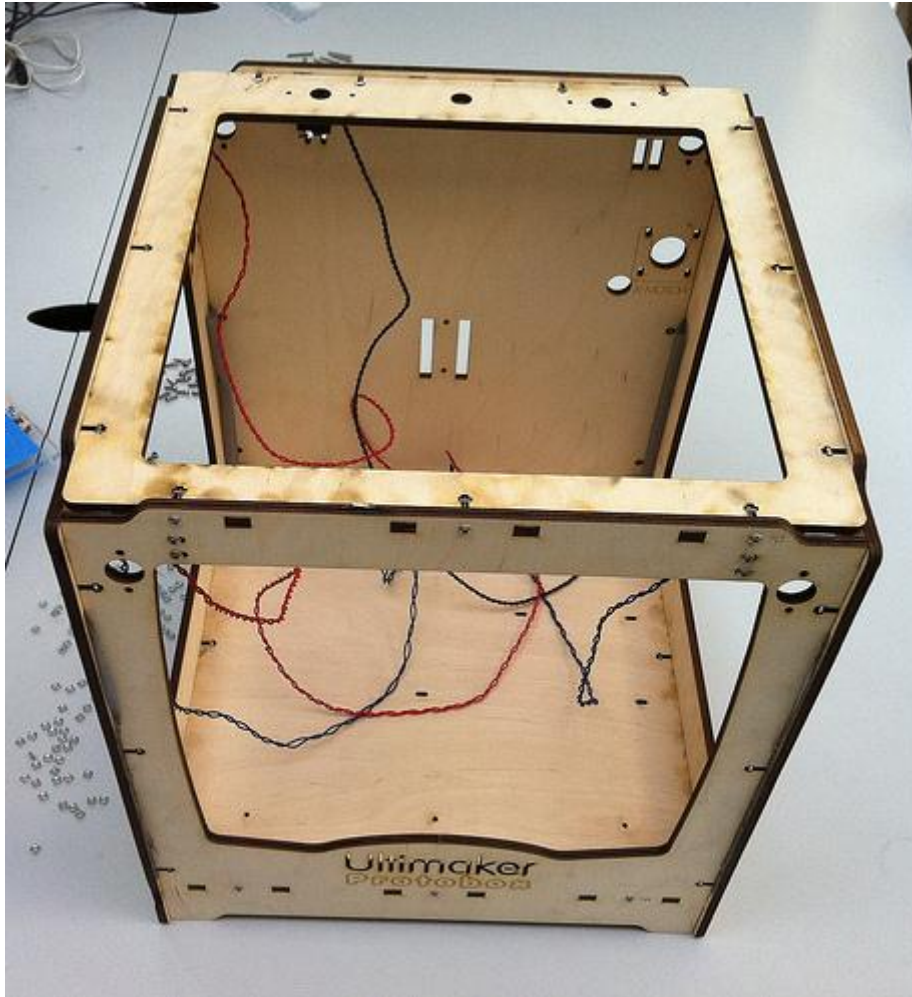
### T-Slots and tabs

T-slots are used throughout the design to connect flat-pack parts at a 90 degree angle.

**Note: Some pictures may show square nuts in places other than T-Slots; just use hex nuts instead on your build.**

## 2 Frame

### Frame assembled



Note:



**Check the laser cut parts. If needed, gently treat them with a small piece of sandpaper to prevent splinters.**

## 2.1 What you'll need



### Time needed:

About 50 to 90 minutes.



### Tools needed:

- Hex keys (2mm)
- 5.5 mm socket wrench or pliers, for M3 Nylock nuts

## Parts needed in this section

Qty.	Description	Notes
6	Laser cut panels (Wood)	Marked LEFT, RIGHT, TOP, BOTTOM, (FRONT) and BACK.
8	Ball bearings 8mm	Used for in the frame.
6	Limit switches	Wired.
4	Cable ducts	Black cable ducts made of kite fabric.
41	Hexagonal M3 nuts	Used anywhere else.
45	Socket cap M3 bolts 16mm	Used in the T-slots.
10	Socket cap M3 bolts 10mm	Used in X and Y switches, and lower Z switch.
2	M3 washers	Used for the (top) Z limit switch
1	Blue Scotch tape	The roll inside the Mega pack.
1	Laser cut part 11A	Reel holder retention plate.
2	Laser cut part 3A	Cover for 12mm diameter holes.
2	M3 Nylock nuts	Used for reel holder retention plate, with blue plastic inside.
4	Velcro	Used to hold the wires together.

The complete frame is built with M3 hex-bolts, with lengths of 10, 16, 20 and 30mm.



**All panels are marked with the side they belong to.**

For all the panels except the front panel, the engravings face towards the inside of the machine. The front panel has the "JoysMakers" engraving on the outside.  
The bottom panel has the engraving faced downward.



**Sanding.**

Before starting the assembly, you may want to slightly sand the panels to remove any burn marks / blemishes from the laser cutting process. You can also paint or stain your JoysMaker. Be aware though that paint will not take very well on the brown cutting edges. If you have received a painted JoysMaker, wipe the smoke marks off with a green scouring pad and soapy water



**Check the Z-Axis holes.**

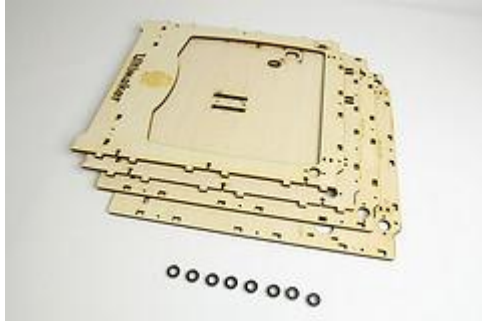
Check if the Z-Axis rods (the really thick ones) fit the 2 holes of the Top and Bottom panel. You will later push both rods through the Top panel all the way down into the bottom. If this seems impossible, turn some sandpaper in the holes. Don't sand too much! The rods should be held firmly in place by the wood. They should not turn easily.

## 2.2 Step 1: Inserting the ball bearings

### Needed in this step

Qty.	Description	Notes
1	Front panel	Wooden panel with the JoysMaker logo.
1	Back panel	Wooden panel marked BACK.
1	Left panel	Wooden panel marked LEFT
1	Right panel	Wooden panel marked Right
8	Ball bearings 8mm	Used for in the frame.

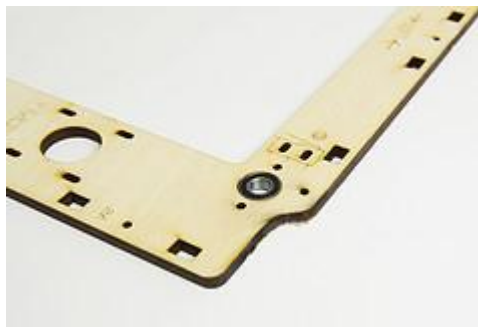




1. Take the frame and push the 8 bearings in the corresponding holes in the frame. You could use a redundant piece of wood to push them in.



**Make sure that the bearings are pushed all the way into the frame. If they are sticking out even a little, they will rub against the wooden endcaps (see section 1.3 X-Y axes) and cause friction in the X/Y axes.**



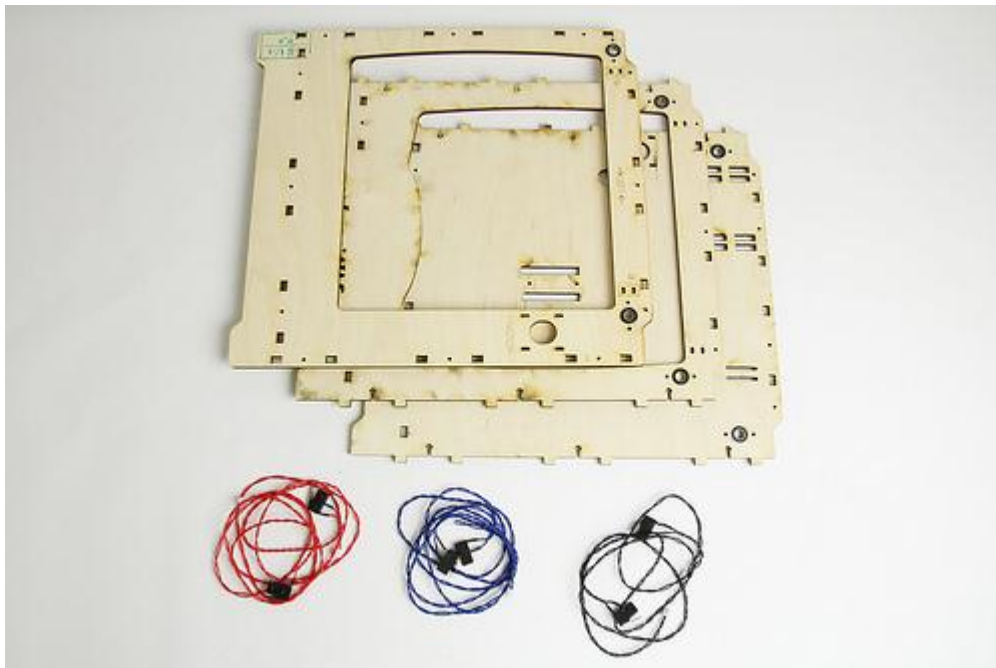
Finally, there should be 2 bearings in each frame.



## 2.3 Step 2: Limit switches

### Needed in this step

Qty.	Description	Notes
1	Front panel	Wooden panel with the JoysMaker logo.
1	Back panel	Wooden panel marked BACK.
1	Left panel	Wooden panel marked LEFT
5	Long Limit switches	Small black box with long twisted wires.
1	Short Limit switches	Small black box with short twisted wires.
10	M3 socket cap bolts 10 mm 10 mm long	
2	M3 socket cap bolts 16 mm	Used in Limit switches, top backside.
2	Washers	Small flat metal rings



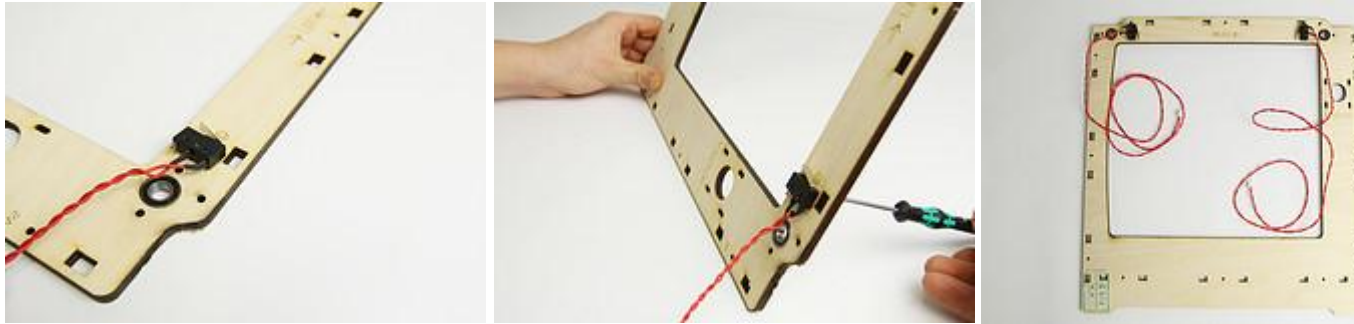
Limit switches (or 'end stops') make sure the machine stops movement of the carriage when it is at the edge of printing volume.



**Don't strain the tapped thread on the inside of the switch housing by putting a lot of force on the bolts. All limit switches are pre-tapped, you can fasten them directly with M3 bolts, no nuts required here!**

Note that all wires of limit switches need to be twisted as seen in the pictures (otherwise they can be triggered by electrical interference, causing strange effects during a 3D print).

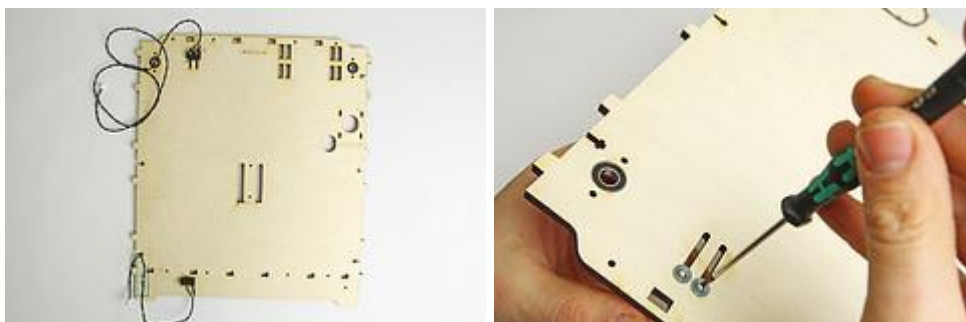
1. Use two M3 bolts (10mm) to mount each of the 2 long limit switches on the backside of the LEFT panel with the lever sticking DOWN.



2. Mount the 2 long limit switches on the backside of the FRONT panel with the lever sticking UP.



3. Mount 2 rest limit switches on the backside of the BACK panel, facing each other and with the levers pointing to the LEFT, use the 10 mm M3 bolts for the lower limit switch and 16mm bolts for the upper switch. The switch with the short wire should be mounted near the (1) marking on wood and the long one should be near the (2). For the limit switch on the top of the back use 2 washers between the head of the bolt and the wood, because it shouldn't slide up. The height of this switch will be fine-tuned at the end.



**Orientation of the switches**

The orientation of the switches are engraved on the panels, except for the frontpanel. In total the machine has 6 limit switches: (1 has a short wire and 5 have long wires).

Note that the LEFT and BACK panel have the text engraved on the inside of the machine (now facing you). Mount the switches to the panels using 10mm bolts, according to the pictures above. On the back panel make sure the switch with LONG wires is mounted on the top, and the switch with SHORT wires at the bottom of the back panel. When you've assembled your JoysMaker, the final position of the switches can be easily adjusted by loosening the bolts, moving them to the desired position and then retightening them. An axis should make a clicking sound when it trips a limit switch.

**Tightening the limit switches**

If it is not possible to tighten the limit switches with 10mm bolts you can use 12mm bolts instead.

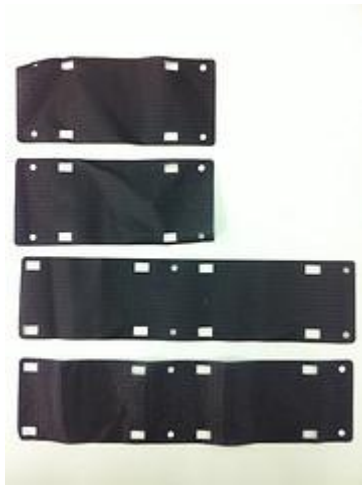
## 2.4 Step 3: Assembling the 'cube'-shaped frame

### Needed in this step

Qty.	Description	Notes
6	Wooden panels	TOP, BOTTOM and RIGHT , plus the panels from the previous step.
1	Blue Scotch tape	The roll inside the Megapack.
37	M3 socket cap bolts	16 mm.
37	M3 Hex nuts	Used for the frame.
2	Black cable ducts-Long	<a href="#">cable organizer pack</a>
2	Black cable ducts-Short	<a href="#">cable organizer pack</a>

**Cable ducts**(For JoysMaker lasted version, we don't provide this, but

replaced by Magic belt)



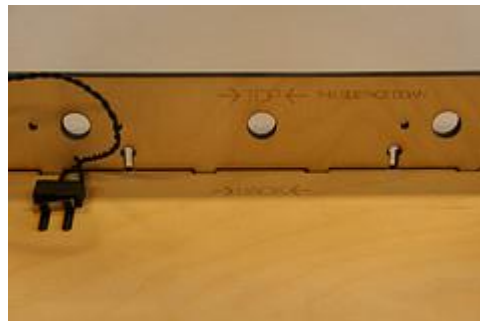
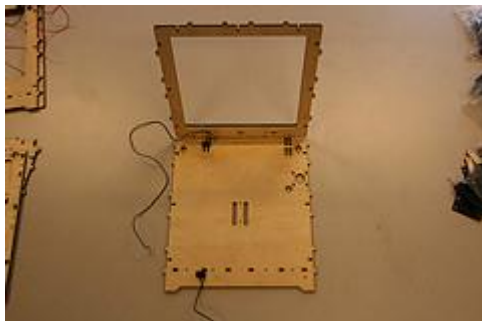
**Be careful not to put any force on the panels because they are weak in this configuration; however they will become very sturdy once you mount a few more panels.**

1. Place the back panel on the table with the markings facing towards you.
2. Insert the TOP panel by placing the tabs of the top panel into the slots of the back panel.



#### Tip when mounting

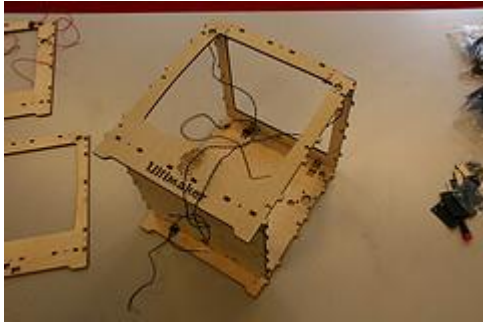
The top panel should fit into the back such that four T slots (not three) line up with the four holes in the back. Also, don't accidentally put the top plate in upside-down. It is symmetrical left to right and will work upside-down, but the engraving will be visible.



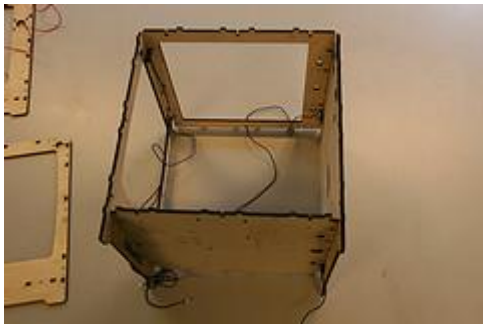
Top and back panel

(close up)

3. Do the same with the BOTTOM panel and then place the FRONT panel on both:



4. Put the frame gently on its side (be careful, it's not bolted together yet!)



5. Take the cable ducts from the [Cable organizer pack](#). You will have 4 cable ducts, 2 longer ones that go at the FRONT of the machine and 2 shorter ones that go at the BACK under the stepper motors.

6. Start with the BACK-RIGHT SHORT cable duct. Fold each cable duct in half along its length and place it over the tabs, so that it forms a pocket that runs along the inside of the frame.

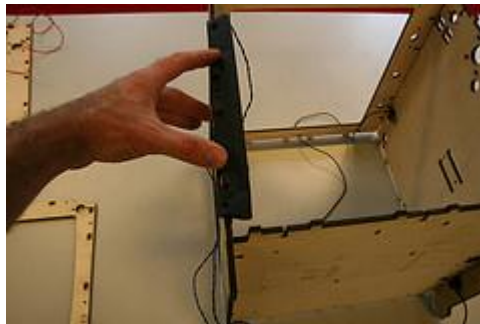


7. Put blue tape on the cable duct to keep it folded. Make sure it can be easily removed a few steps further along.

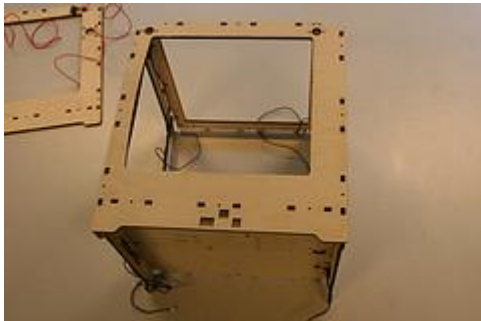




8. Do the same for the FRONT-RIGHT LONG cable duct (also use blue tape). Ensure the small round holes in the cable duct align with the T slots in the front panel.



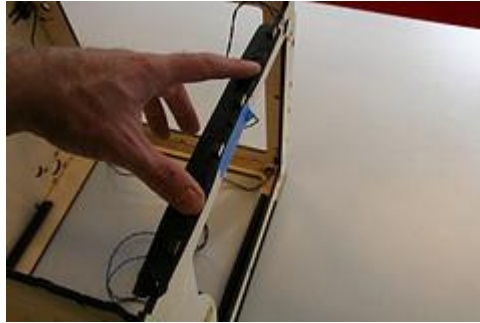
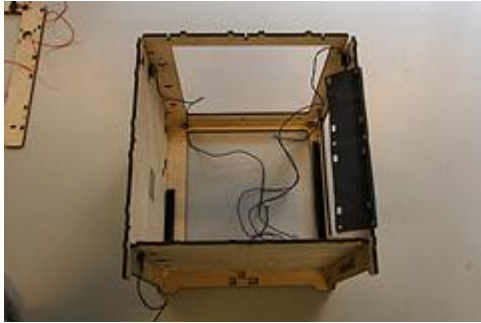
9. Now that both cable ducts are in place, you're ready to fit the RIGHT side panel. Fix with a few bolts, you might need to disassemble later if you made a mistake.



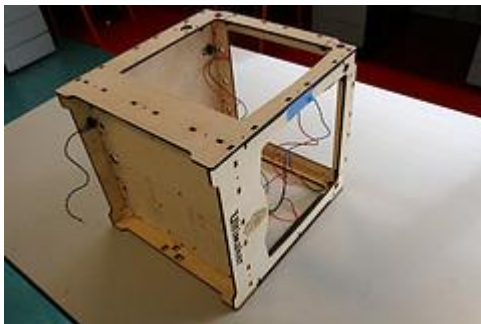
10. If everything fits, remove the blue tape.



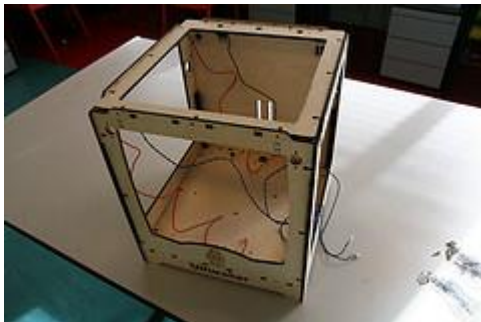
11. Turn the machine on its right side and place the 2 remaining cable ducts in a similar way. The long one on the front, and the short one on the back.



12. Place the left side panel and remove the blue tape again.



The frame should now look like this:



13. Bolt the frame together.

#### Inserting nuts



Insert the nuts into the T-slots where they will not fall out (where panel is vertical), or use your finger to keep them in place. Use 16mm bolts to fasten the panels together. Add a nut and fasten it, then go on to the next one, until the whole frame is fastened together nicely. Make sure no cables get jammed before tightening. Also, beware of overtightening, since the wood gives in easily.





14. Then guide the end stop wires through the cable ducts and through the holes in the corners.



When done, the frame should look like this:



## 2.5 Step 4: Mounting various parts

### Needed in this step

Qty.	Description	Notes
4	Pieces of Velcro	To hold the wires on the bottom together.
1	Wooden part 11A	A square block with 4 square holes.
2	Wooden part 3A	To cover the holes at the bottom panel
6	M3 socket cap bolts 16 mm.	

4 M3 Hex nuts	not the square ones.
2 M3 Nylock nuts	with blue plastic inside.

1. Mount the reel holder retention plate (11A) with Nylock nuts (blue plastic on the inside).



**This panel is mounted on the outside of the machine and two 16mm bolts are inserted from the INSIDE of the frame.**



2. Mount 2 parts labeled 3A on the underside of the machine (at the back) using 2 16mm bolts and let them cover the 12mm diameter holes.

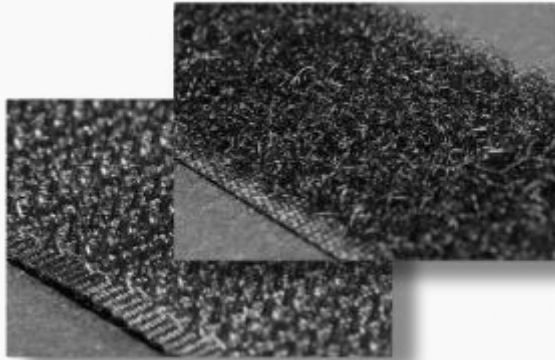


**These parts should be 6mm thick. The 4mm thick ones are used at the top after the 12mm rods are inserted.**



3. Slide the 4 pieces of black Velcro through the 4 holes on the BOTTOM panel of the machine.

## Velcro: tidy your wires

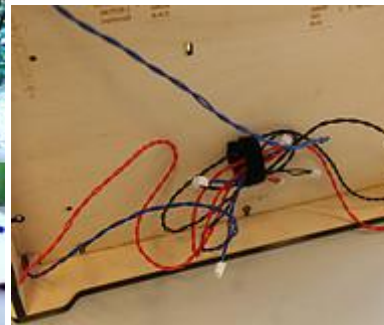
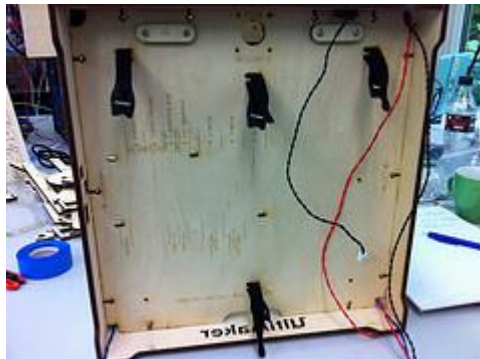


mount these at the bottom of your machine.



### Organizing cables

You can use the Velcro to keep the wires out of the way during further assembly. The Velcro's front side will stick against its back-side.



Great work! The frame is now ready! On to the next section.

## 3 Motors

### 3.1 What you'll need


**Time needed:**

About 20 to 40 minutes.


**Tools needed:**

- Hex key (2mm)
- Hex key (1.5 mm)

### Parts needed in this section

Qty.	Description	Notes
3	Motors with simple round axles	simple the one with the short wire is for the Z-axis, the 2 other for X and Y. The fourth one is for the extruder later.
1	spacer pack	For the X-Y-motor.
8	Bolts 20 MM	For the X & Y motors.
4	Bolts 10 MM	For the Z-motor.
2	Short timing belts	For the X & Y motors.
8	Washers	Should fit on the bolts
2	Pulleys	For the X & Y motors.
1	Resiliert coupling	For the Z-motor.



### 3.2 Step 1: The X and Y motors

#### Parts needed in this section

Qty.	Description	Notes
2	Motors with simple round axles	The one with the short wire is for the Z-axis, the 2 other for X and Y.
2	Pulleys	For the X & Y motors.
2	Short timing belts	For the X & Y motors.
8	Bolts 20 mm	For the X & Y motors.
8	Washers	Should fit on the bolts.
8	White spacers	For the X and Y motors.



For this step you have to take 2 motors with long wires.

1. Prepare the two motors by placing the 5mm internal diameter pulleys on the two motors. Keep a tiny gap in between the motor and pulley and fasten it very tightly.



**Because of the tiny gap, the pulley should rotate freely.**

2. Put 4 bolts (20mm) with washers through the holes on the outside (not engraved) of the BACK panel on the place where the motor needs to be mounted. Next, take 4 white spacers and place each one around one of the bolts (on the engraved side of the frame).



3. Take one of the motors and lay the timing belt around the pulley.





4. Put the motor in place. Make sure the wires of the motor, the wires of the limit switches and the timing belt don't get stuck!



5. Hold the motor with the timing belt and tighten it just a little bit with the 4 bolts, so it can slide up and down a little. These bolts will be tightened later when all axes are in place.



#### Mounting the washers



You should use 4 washers on the bolts in the X and Y motors to ensure that the motors will not slide upward. This helps maintain belt tension for the short belts. If you somehow do not have 3mm washers in the [nuts and bolts pack](#), you can use any 3mm (or 1/8 inch) washer from the hardware store.

6. Do the same for the Y motor and mount this one to the LEFT panel. Make sure you push the cables into the corner before mounting the Y motor.



7. Push the wires through the cable ducts and out through the bottom panel.



### 3.3 Step 2: The Z-motor

#### Parts needed in this section

Qty.	Description	Notes
1	Motors with simple round axles	the one with the short wire.
4	Bolts 10 MM	For the Z-motor.
1	Resiliert coupling	For the Z-motor.
1	Hex key	The small one, used for tightening the Resiliert coupling.

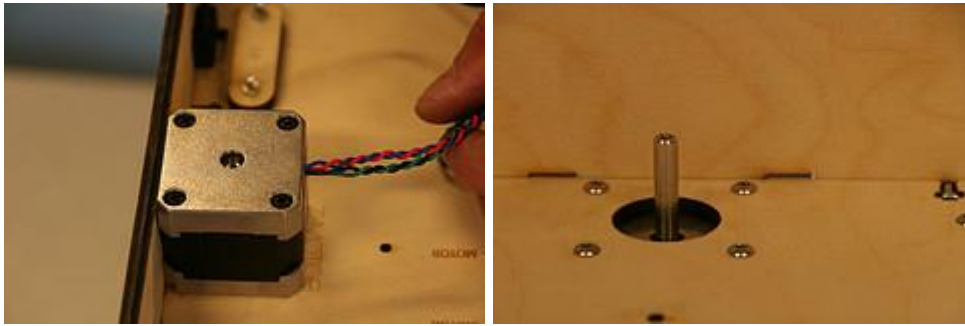


1. Take the third motor (with the shortest wires) and mount on the underside of the bottom panel. Use 4 bolts of 10mm. Make sure that the wires stick out towards the center of the bottom panel.



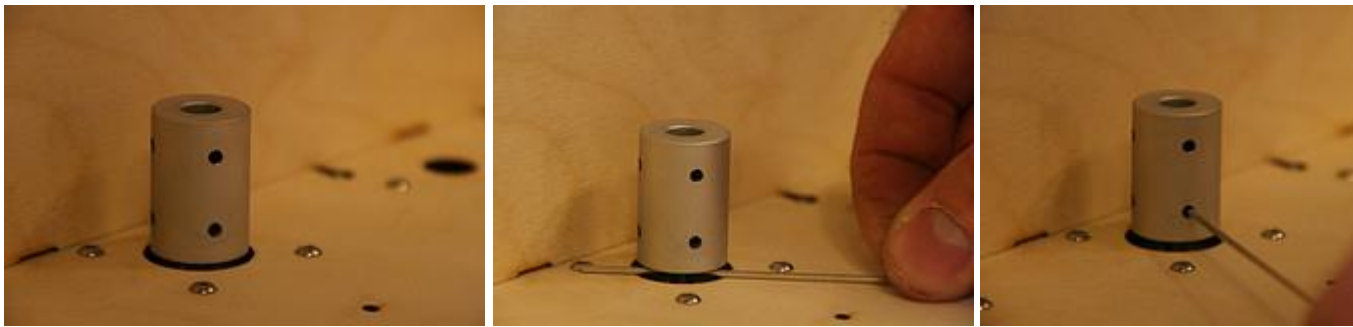
**Because there is no clearance between the motor and the back, be sure to force the motor face to seat flat on the bottom.**





2. Take the Resiliert coupling (you can find it within the little white package in the Pulley Pack) and place it on top of the motor. The Resiliert coupling has two different sides, a 5mm and an 8mm - you need to put the 5mm side on top of the motor.

3. Use a screw driver to set the Resiliert coupling at the right height and tighten the small screws at the bottom of the Resiliert coupling with the hex key.



## 4 X-Y axes

### 4.1 What you'll need



This is one of the more tricky steps. Make sure you're fully caffeinated and/or relaxed, or whatever works best for you!



**Time needed:**  
About 60 to 90 minutes.



**Tools needed:**

- Hex keys (2mm)
- Hex key (1.5 mm)

### Parts needed in this section

Qty.	Description	Notes
16 Bolts 16mm		Used for the bushing blocks.
16 Bolts 30mm		Used for the bushing blocks.
16 Bolts 10mm		Used for the bushing blocks.
56 M3 Hex Nuts		Used for the bushing blocks.
2 8 mm Axes short		Works as a slider for the belt.
2 8 mm Axes long		Works as a slider for the belt.
10 Timing pulleys		Used for on the axis.
4 Timing belts		Will work together with the pulleys.
24 Wooden parts		See picture in step 2

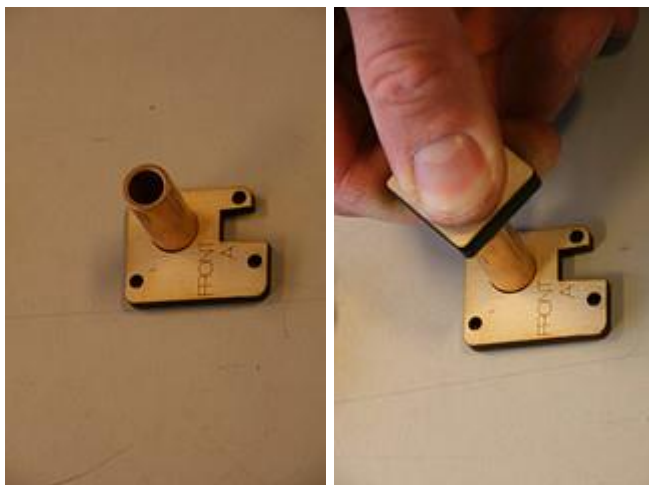
8	Linear bronze bushings 8 mm x 11mm x 15mm long	Needed in step 2
4	wooden part insert marked C	Needed in step 3
8	wooden caps without hole	See picture in step 4
6	wooden caps with hole	See picture in step 4

## 4.2 Step 1: Assembling the X/Y slider blocks

Parts needed in this step		
Qty.	Description	Notes
16	Bolts 30 mm	See picture below
8	Bolts 10 mm	See picture below
28	M3 Nuts	See picture below
24	wooden parts	See picture below
4	linear bearings 8 mm x 11mm x 30mm long	Found in axes pack, See picture below

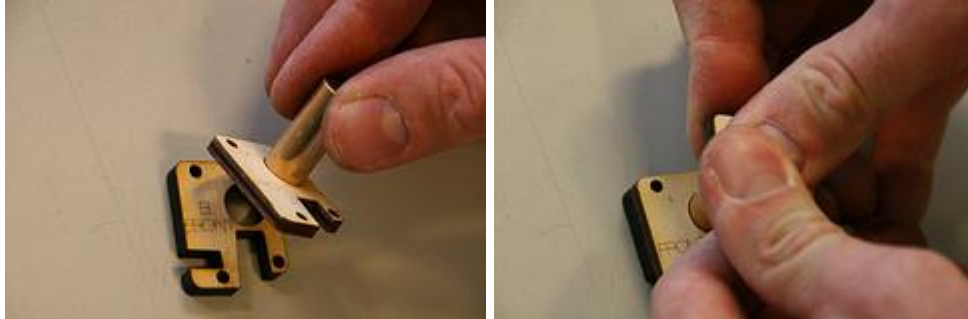


1. Push the bearing in part FRONT A. Use a redundant piece of wood to push it in.

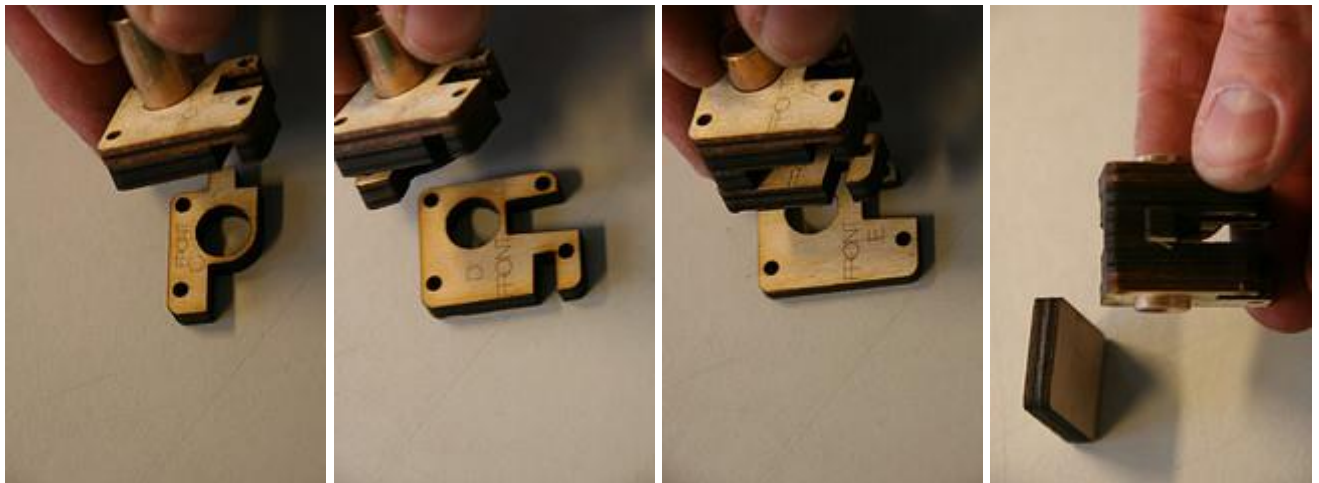


2. Put it on top of part FRONT B and push 2 bushing further in.(note, in bellow picture it showed as 1 30mm long bushing, but for JoysMaker version, it is

replaced by 2 15mm bushing. Problem for it will be the alignment for two bushings. Here is a way to do it: after you assemble the slider and push the 2 15mm long bushings in, you can mount it into the 8mm axes, and knock it to the ground with the plane side downward, it will solve the alignment issue.)



3. Continue with part FRONT C, FRONT D and FRONT E, until all parts are stacked together and the bushing is inside.



4. Do the same for the LEFT, RIGHT and BACK sliding block.



**Assemble each block in the following order A-B-C-D-E (from top to bottom) with the text facing the same direction on each part of the block.**

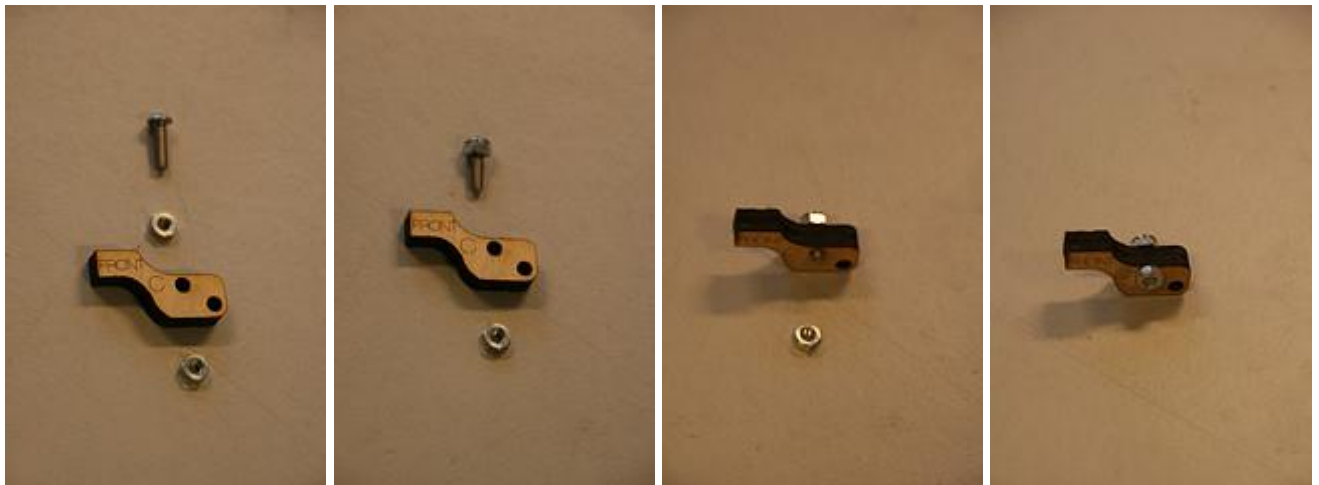
Once assembled only the "A" on the TOP will be visible.

### 4.3 Step 2: The claws

#### Parts needed in this step

Qty.	Description	Notes
4	wooden parts marked FRONT C, RIGHT C, LEFT C and BACK C	needed for the claws
4	wooden parts insert marked C	needed for the claws
8	Bolts 10mm	needed for the claws
16	Bolts 30 mm	See picture below
12	M3 Nuts	needed for the claws

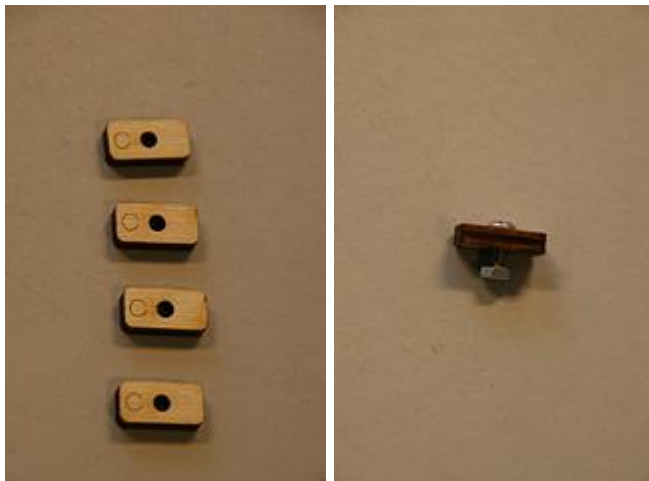
1. Use a 10mm bolt and two hex nuts in order to assemble the 'claw' part that will grab onto the timing belt. The hex nut will just barely fit, this is normal.



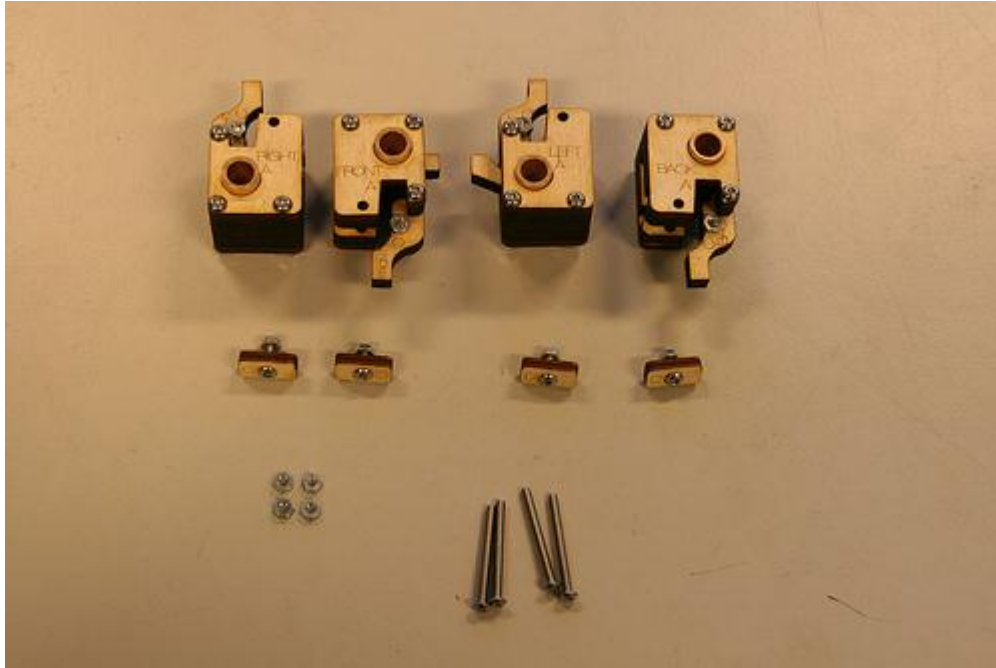
2. Now place 3 of the 30mm bolts on the side with the text markings, and add the nuts on the other side. **DON'T TIGHTEN THEM TOO MUCH YET**, the clamp should be able to rotate!



3. Assemble the small insert (marked C) with a 10mm bolt and add a nut. This is the part that will clamp the crossing rods.



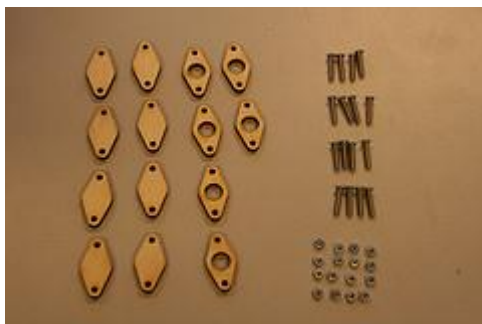
4. It should now look like the picture below, the blocks are ready to be mounted, but you will do this in a later step.



#### 4.4 Step 3: Mounting the caps

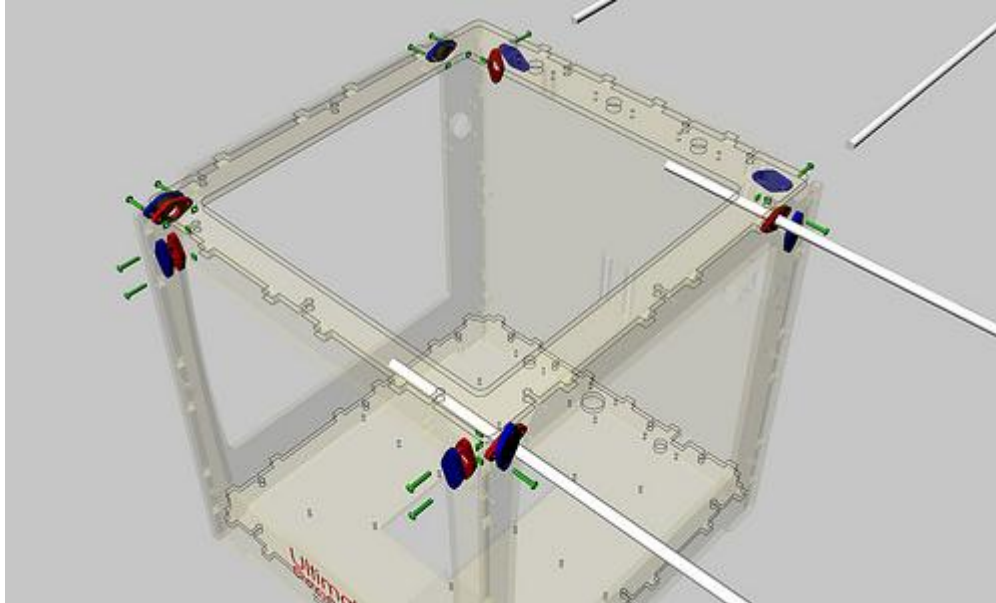
##### Parts needed in this step

Qty.	Description	Notes
8	wooden caps without hole	See picture below
6	wooden caps with hole	See picture below
16	M3 Nuts	See picture below
16	16 mm Bolts	See picture below



1. Now the caps can be mounted so the axes will stay in place and won't slide out during operation. The order in which the caps should be mounted is quite important. In the picture below, you'll see how the axes can be slid in from the right and back side, so the caps on those sides should only be partly mounted.





2. Follow the order of the caps in the pictures below!!

3. Start with the cap on the front of the machine. Start with the left cap on the frontpanel. It needs a closed cap on the outside and a cap with a hole on the inside.



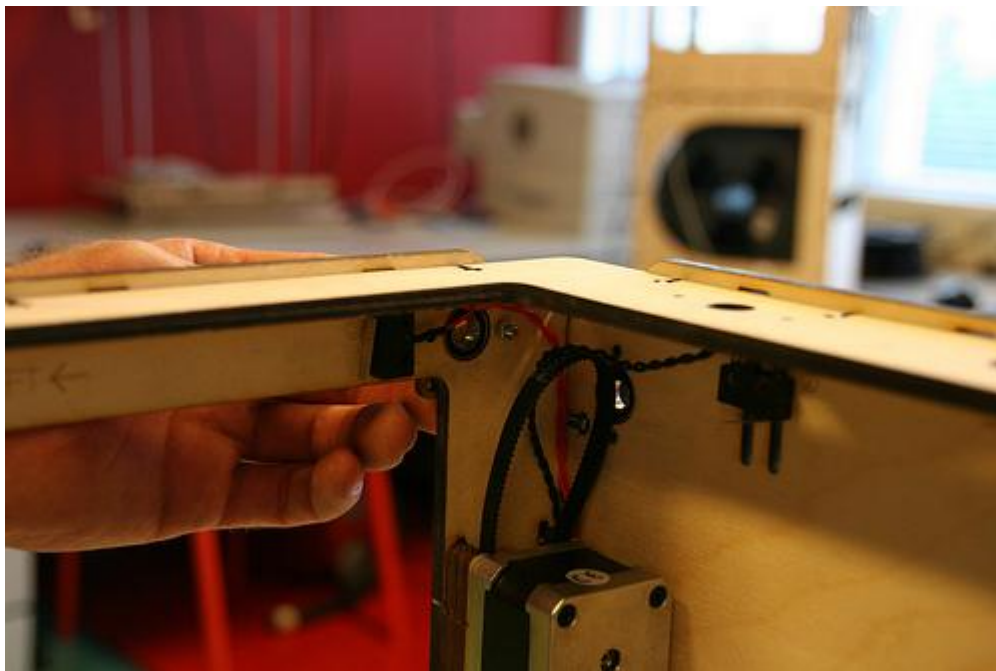
4. Follow with the cap on the front right. It needs a closed cap on the outside and a cap with a hole on the inside.



5. Now the caps on the left side can be mounted. Start with the left front. It needs a closed cap on the outside and a cap with a hole on the inside.



7. Follow with the left back. It needs a closed cap on the outside, but NO cap on the inside. The bearing will be secured in place by a gear inside the machine on the axes which will be installed later. Check the illustration, above with the red and the blue caps. Make sure the wires are guided nicely.



**Closed caps**

that the closed caps should not cover the hole on the RIGHT and BACK side of the machine, but they can be mounted on the opposing sides. You can put one bolt through them in the corner which will be hard to reach afterwards, but don't bolt the other side, because you need to be able to insert the rods. The places where a cap with a hole aren't used are directly above the stepper motors.

8. Now mount the caps on the right panel. They both have a cap on the outside and a cap with a hole on the inside. Only bolt them together with 1 bolt and leave the cap rotated on the outside so the rod can be slid in (see next section). The cap on the inside should be mounted correctly.



9. Now mount the caps on the back panel. Only bolt them together with 1 bolt and leave the cap rotated on the outside so the rod can be slid in (see next section). The axis hole on the side above the X-motor only has a cap on the outside. The axis hole on the left-back side (seen from the front) should have a cap on the inside.



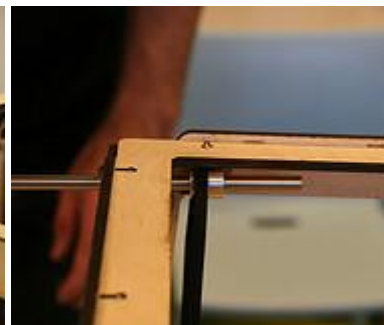


## 4.5 Step 4: Mounting the axes

### Parts needed in this step

Qty.	Description	Notes
2	8 mm Axes short	Works as a slider for the belt.
2	8 mm Axes long	Works as a slider for the belt.
8	Timing pulleys	Used for on the axis.
4	Timing belts	Will work together with the pulleys.

1. Start with the front axes.
2. Check if you have the correct length of axis. There are 4 axes with a diameter of 8mm--2 are short and fit left side to right side, and 2 are a little longer and fit front to back. For the first axis, pick one of the shorter ones.
3. Slide the axis in the front of the machine.
4. Then put 1 timing pulley on the axis with the fastening screw of the pulley like in the picture.
5. Take 1 timing belt and place it around the pulley.
6. Then slide the FRONT sliding block on the axis, **text readable and the text facing LEFT side of the machine.**



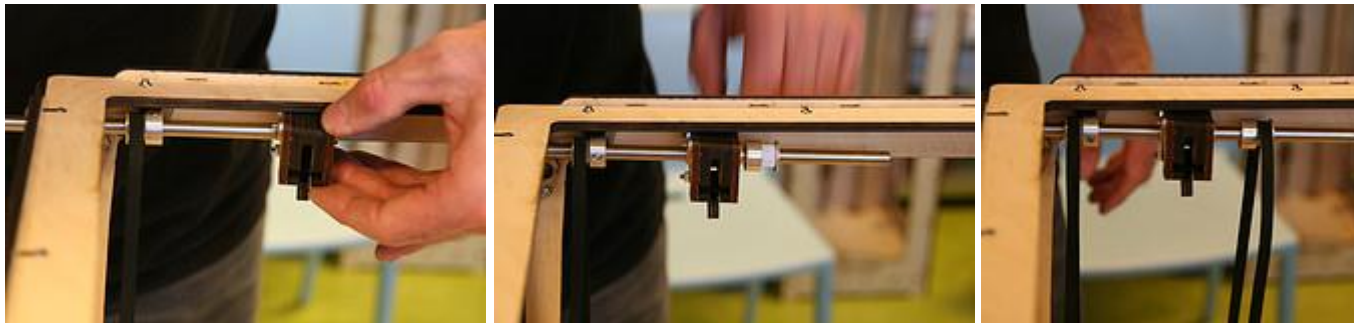
### VERY IMPORTANT: Orientation of the Axes



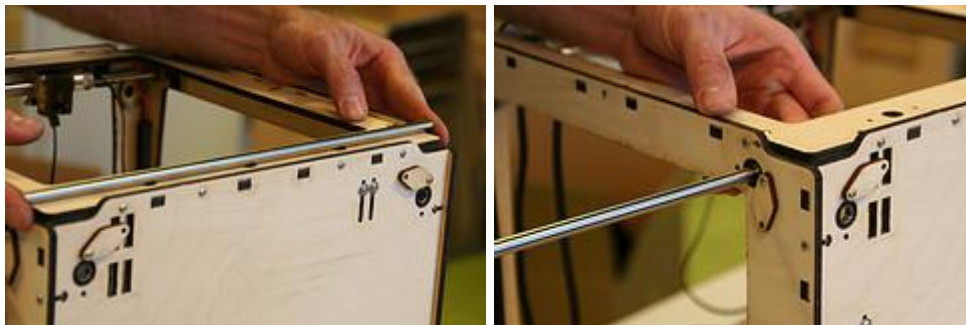
Mind the orientation! The hinge mechanism of the sliding blocks should be facing DOWN for the FRONT and BACK Axis and they should face UP for the LEFT and RIGHT axis. The part C of the sliding blocks should always be facing inwards the machine. See the picture below for correct placement of the timing pulleys and sliding block. In general each of the blocks will be clamping onto a belt attached to a pulley on a rod going in the other direction, the hinge

on the block will be on the side that the belt passes by the block.

7. Next, slide the other pulley on the axis, also with the fastening screw facing inward.
8. Do the other timing belt on the pulley and slide the axis all the way into the bearing on the other side.
9. Rotate the cap and fasten it with a second bolt.
10. Tighten with the nut.



11. Slide in the back axis from the right. **First check if you have the correct length (a short axes).**



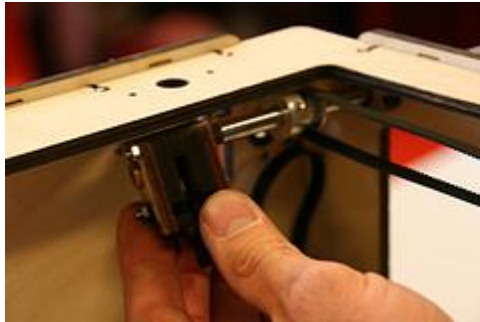
12. First take 1 timing pulley in your hand,
13. Put the belt that is attached on the opposite axis around the pulley (again the fastening screw facing to the inside of the machine).
14. Slide it on the axis.



15. Now take the BACK sliding block and slide it on the axis, **text readable and the text facing RIGHT side of the machine.**

16. Take another timing pulley and put the second timing belt of the opposite axis around the pulley (fastening screw facing inward the machine) and slide it on the axis.

17. Take a third timing pulley and slide it on the axis in the same orientation as the previous one.

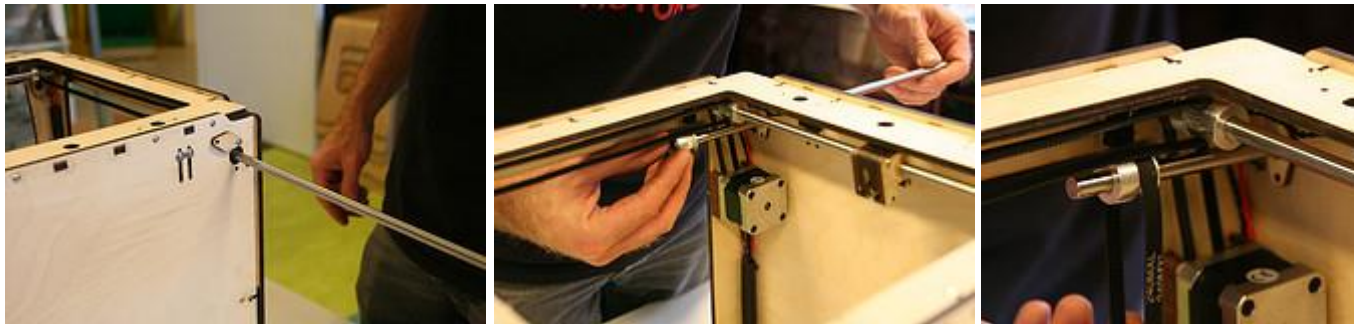


18. Move the axis with the pulleys towards the bearing on the other side, but make sure you put the timing belt of the motor around the third pulley.

19. Slide the axis into the bearing and mount the cap on the frame.



20. Slide in the left axis [a longer one] from the back of the machine (i.e. the top left corner when the machine is face down).
21. Put 1 timing pulley on the axis with the fastening screw facing inward the machine.
22. Take 1 timing belt and place it around the pulley.
23. Slide in the LEFT sliding block, **text readable and the text facing FRONT side of the machine.**
24. Slide the second timing pulley on the axis, with the fastening screw facing inward the machine.
25. Take another timing belt and place it around the second timing pulley.
26. Slide the axis all the way into the bearing and fasten the cap.



**Do yourself a favour and put the timing belt already in the clamp mechanism. It will save you some fiddling later on.**



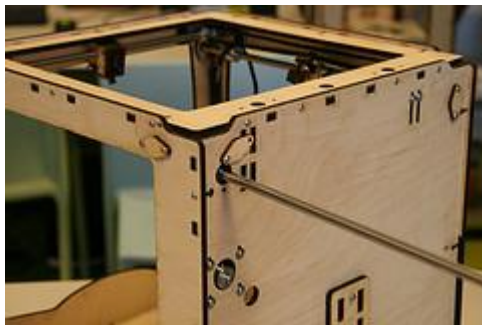
27. Finally the right axes can be put in place.
28. Slide in the right axis [a longer one] from the back of the machine (i.e. the top right corner when the machine is face down).



29. Put 1 timing pulley on the axis with the fastening screw facing inward the machine.
30. Take the long timing belt from the front of the machine and place it around the pulley.
31. Slide in the RIGHT sliding block, **text readable and the text facing BACK side of the machine.**
32. Slide the second timing pulley on the axis, with the fastening screw facing inward the machine.
33. Take the long timing belt from the back of the machine and place it around the second timing pulley.
34. Slide the third timing pulley on the axis, with the fastening screw facing inward the machine.
35. Take the timing belt from the X-motor and put it on the pulley.
36. Slide the axis all the way into the bearing and fasten the cap.

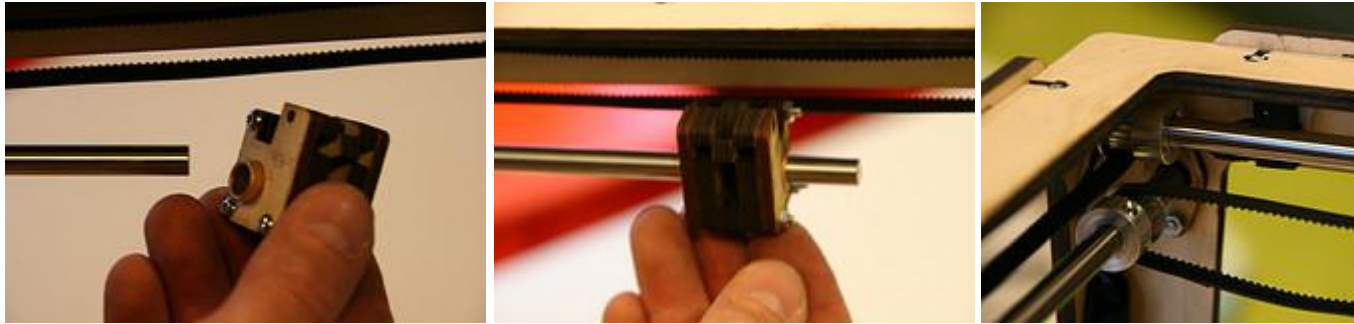


**When you bolt the motor, make sure you push it downward so that the small timing belt is completely tight, otherwise this will cause backlash. When the motors get hot and cool down a few cycles, this may allow the bolts to sink into the wood a little, causing the X and Y stepper motor to start sliding upward again. You can prevent this by tightening it more in advance, or by re-tightening it when it has heated up and cooled a few times.**



**Again do yourself a favour: put the timing belt already in the clamp mechanism to avoid some fiddling.**

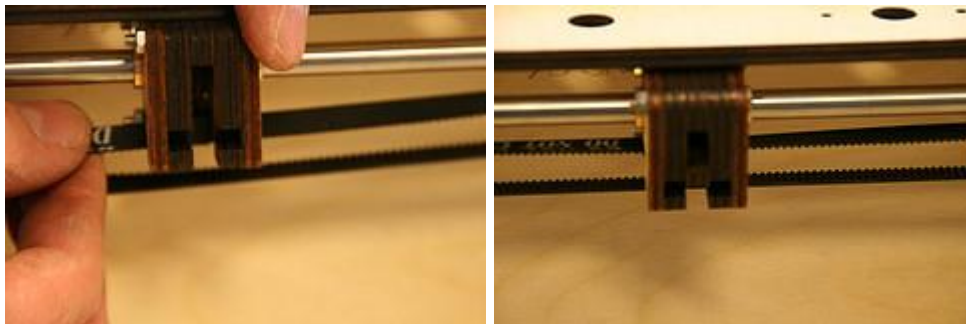




37. The timing belts need to be clamped in the sliding blocks. Start with the front sliding block.



38. Similar for the sliding block in the back:



39. The left and the right sliding block are a little more difficult.





40. You should now have four C parts left for the sliding blocks, you will use them in the next chapter.

41. Take a sip of you coffee and relax for a moment.

## 5 Extrusion head

**Time needed:**

About 60 to 90 minutes.

**Tools needed:**

- Hex keys (2mm)
- Hex key (1.5 mm)
- Tweezers
- Pliers
- Small screwdriver (1.5 mm)

## 5.1 Contents

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## 5.2 Step 4 - the EXTRUDER

## 5.3 What you'll need

### Parts needed in this section

Qty.	Description	Notes
6 m3 nuts		2 used to mount for thermocouple, 4 used in the extrusion frame.
5 m3 bolts 10 mm		1 for the heating part, 4 used in the extrusion frame.
2 m3 bolts 30 mm		Used to mount the thermocouple.
4	<u>wooden parts named FRONT, BACK, RIGHT, LEFT</u>	Named with 8A which means that they fit in 8A.
1	<u>wooden part named 8B</u>	This one can be found in the extrusion pack, and is milled on one side in two holes.
1	<u>wooden part named 8B</u>	this one is from the laserpack, <b>NOT MILLED and NOT NEEDED.</b>

1 <a href="#">wooden part named 8A</a>	looks like 8B but this one is NOT milled.
2 <a href="#">linear bearings</a>	Metal tubes.
1 <a href="#">push in fitting</a>	Tiny small plastic tube.
1 <a href="#">PFA tube</a>	Transparent tube, one side taped blue.
1 <a href="#">horse shoe</a>	iny blue U-shaped plastic that will stick later on the fitting.
1 <a href="#">m6 brass pipe</a> *	*these pieces might be screwed together.
1 <a href="#">nozzle bolt</a> *	*these pieces might be screwed together.
1 <a href="#">aluminium heater block</a> *	*these pieces might be screwed together.
1 <a href="#">aluminium plate</a>	with 4 holes.
1 <a href="#">peek insulator</a>	with m6 screw-thread inside.
1 <a href="#">tiny piece of plumbing tape</a>	needs to be used in between the peek and brass pipe.
1 <a href="#">heater</a>	solid metal pipe with wires.
1 <a href="#">thermocouple</a>	smaller solid metal pipe with wires.
1 <a href="#">thermocouple board</a>	Tiny green board with electronics.
1 <a href="#">comb-shaped strain relief</a>	tiny black plastic.
2 <a href="#">White plastic nuts</a>	will fit the 2 30mm bolts.
1 <a href="#">tiny transparant acrylic</a>	should be mounted underneath the thermocouple board.
4 <a href="#">m3 studding</a>	long bolts, +-95 mm with a black top part.
1 <a href="#">cooling fan</a>	Used the assemble the cooling fan.
1 <a href="#">black polypropylene fan duct</a>	Used the assemble the cooling fan.
2 <a href="#">m3 bolts 16 mm</a>	Used the assemble the cooling fan.
4 <a href="#">m3 hex nuts</a>	Used the assemble the cooling fan.
4 <a href="#">wooden parts named C</a>	used for the tensioning of the belts.
2 <a href="#">6mm axis</a>	sliders for the extrusion head.
4 <a href="#">30mm m3 bolts</a>	used for mounting the housing of the XY frame.
4 <a href="#">m3 nuts</a>	used for mounting the housing of the XY frame.

## 5.4 Before you start, please read this carefully!

If you are updating from Hot end V1, you have to disassemble your extruder head first. Unscrew the small C parts in the sliding blocks that keep your axis in its place. Take out the X and Y axis. Remove them from the housing and strip it from its parts gently. *You have to re-use some parts.* In the picture below you can see what parts you need to upgrade to Hot End V2. Note: The acrylic mounting plate and comb-shaped strain relief have a slightly new design, please use the upgraded version. If this is the first time you are building your extruder head, ignore these instructions and continue reading the assembly guide below. Thank you.

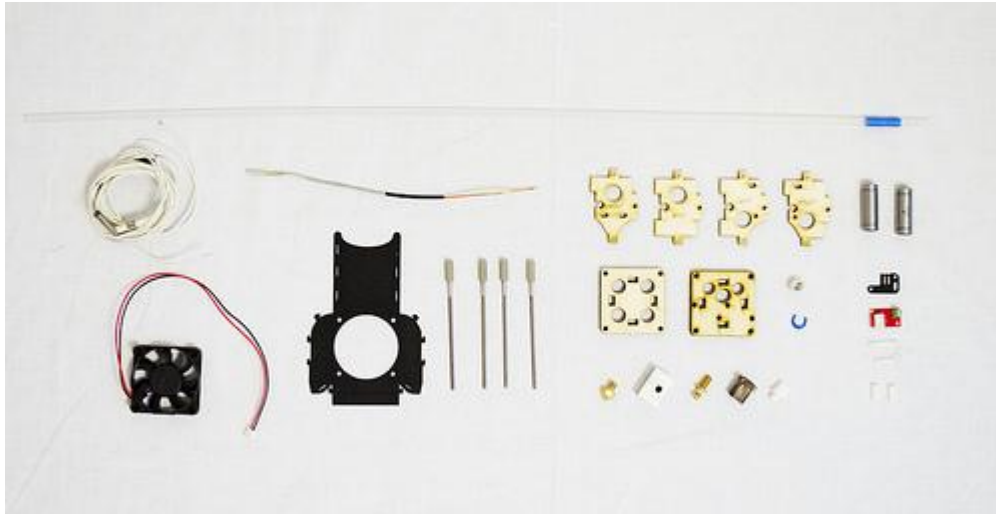
### Parts needed in this section

Qty.	Description	Notes
1	wood FRONT/BACK/LEFT/RIGHT	These 4 wooden parts will create the center piece, the housing of the extruder head.
1	Wooden part 8A	The top of the extruder head.
1	Wooden part 8B	The bottom of the extruder head.
1	Acrylic mounting plate	Goes under the amplifier circuit board
2	threaded spacers	Will hold your strain relief up.
1	PEEK	Part of the hot end
1	Aluminum heater block	Part of the hot end
1	Brass pipe	Part of the hot end
1	0.4 Nozzle	Part of the hot end
1	Strain relief	Protect your wires
1	Teflon insulator	Part of the hot end
1	Bowden tube clamp, colours may vary	Will hold the bowden tube at its place
1	Horseshoe, colours may vary	Keeps the tightner under tension
2	Lineair bearing	For the axes
1	Cartridge heater	Will heat your hot end
1	Thermocouple	Will read the temperature
1	Aluminum plate	For under the extruder head
1	Amplifier circuit board	Goes on top of the extruder head

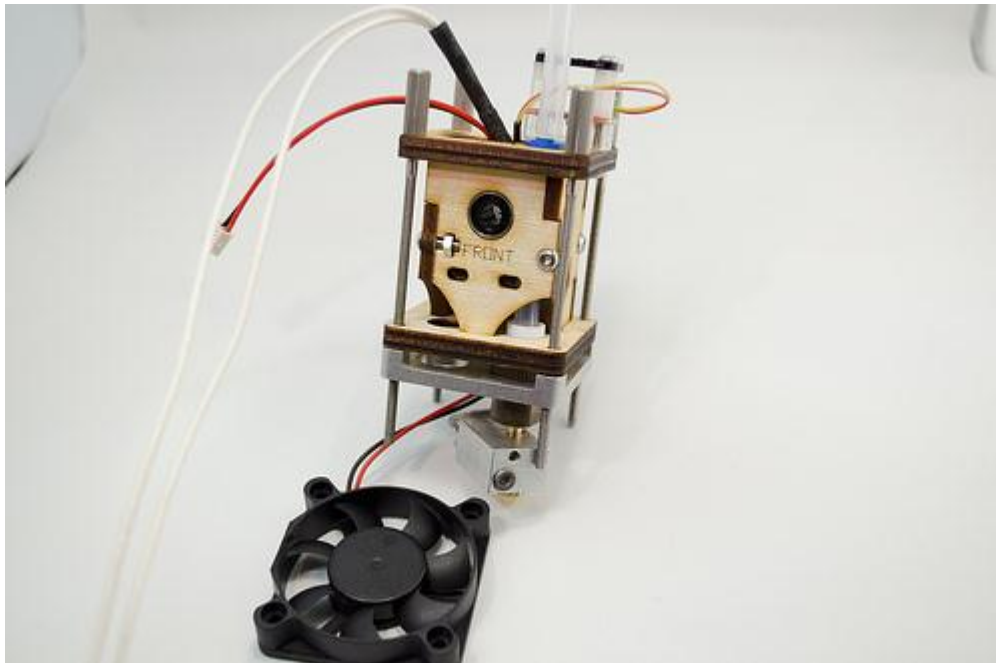
### Tools

- 1 HEX-screwdriver
- 1 Small flat screwdriver

## You need these parts



## This is the goal:



### 5.4.1 Lets start!

1. Grab the aluminum heater block, and hold it so the biggest hole at the side is at the right- bottom corner. Screw the nozzle in the bottom, and the brass pipe on top



like show on the picture. Pay attention that the brass pipe isn't showing a thread on the part that sticks in the aluminum heater block.

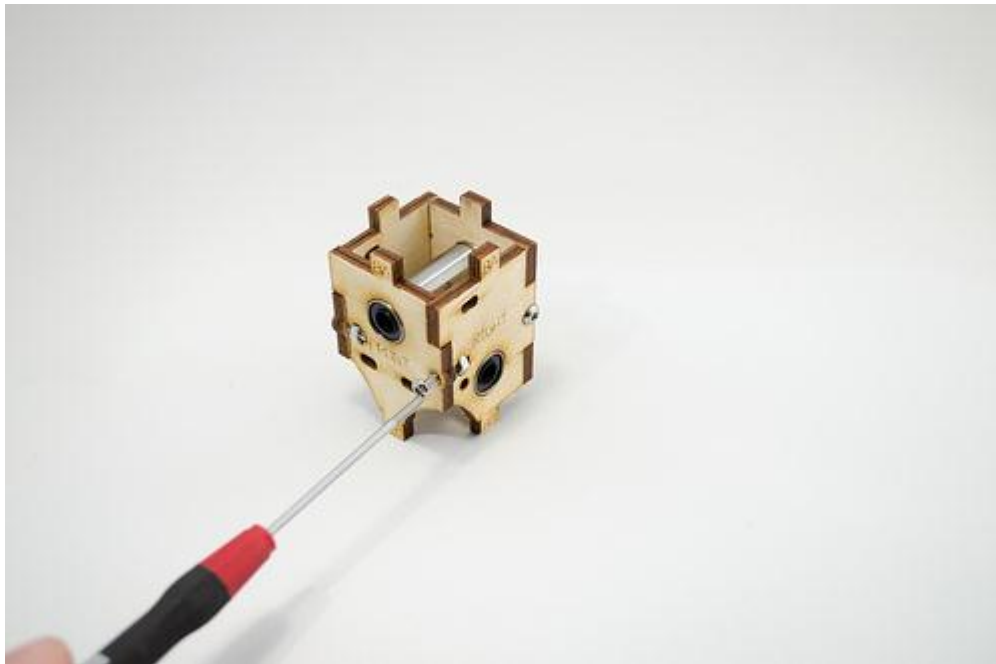


2. Now get the 4 wooden sides from the housing marked with FRONT, BACK, LEFT and RIGHT. Put these in front of you with the markings facing up. Take 1 linear bearing and stick it in the back of wooden plate FRONT, without letting it stick out from the front. Repeat this with the other bearing and wooden plate LEFT.





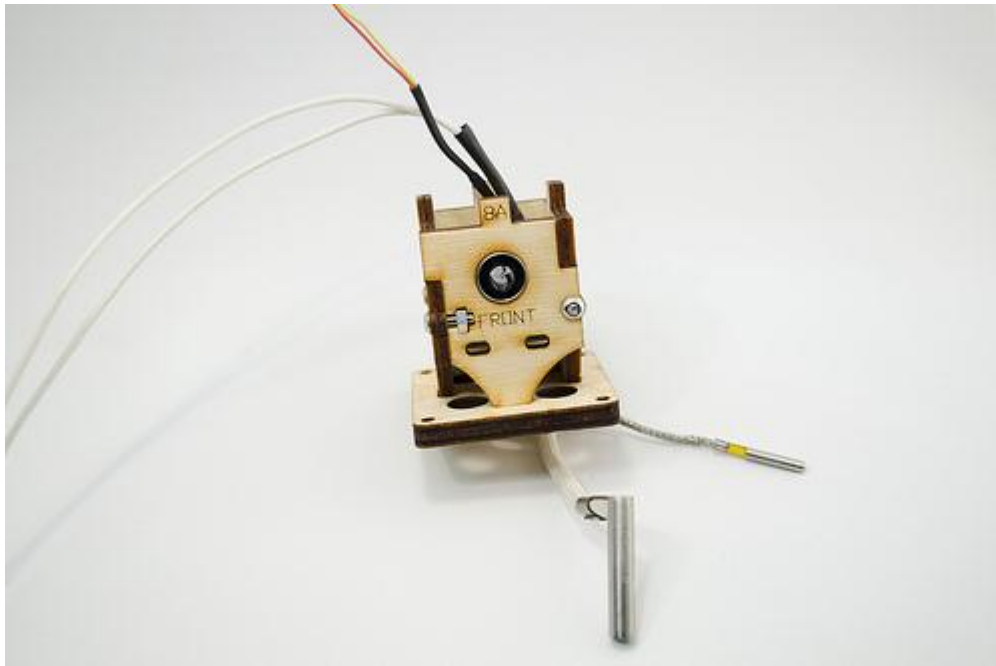
3. Get wooden plate RIGHT and put this on the other side of the bearing that is in wooden part LEFT. Take wooden part FRONT and put it between wooden part LEFT and RIGHT like shown on the picture. Keep the engraved sides on the outside. Now take wooden part BACK and put it on the other side of wooden part FRONT so the housing is now complete. Screw the housing together with M3 10mm screws using the T-slots.



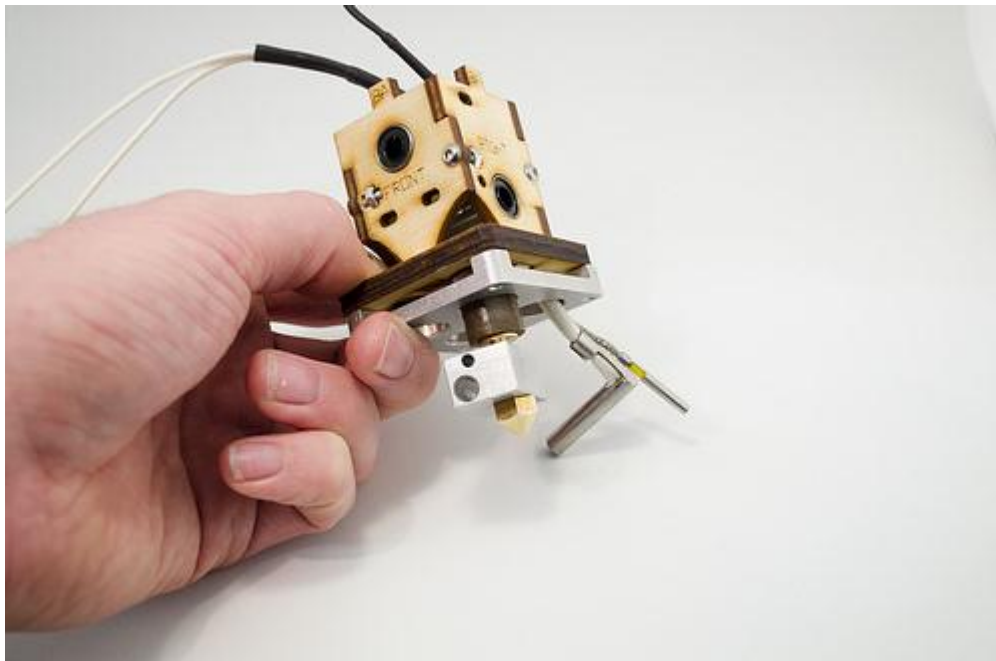
4. Put the housing you have just created in wooden part 8B.
5. Get the aluminum plate and put the PEEK through the hole in the front right hole. (it is symmetrical, so you may decide what front right is).
6. Take the aluminum heater block, Nozzle and Brass pipe you just assembled and screw this in the PEEK like shown on the picture. Make sure the brass pipe can't move in the PEEK and the entire hot end is screwed tight.



7. Take wooden part 8B and the cartridge heater. Grab the 2 wires belonging to the cartridge heater, and stick these through the hole in the back right of wooden part 8B. Stick them through until there is only a few cm left in the front.
8. Take the Thermocouple and wooden part 8B. Stick the red and yellow wire from the Thermocouple through the same hole as the cartridge heater in wooden part 8B.



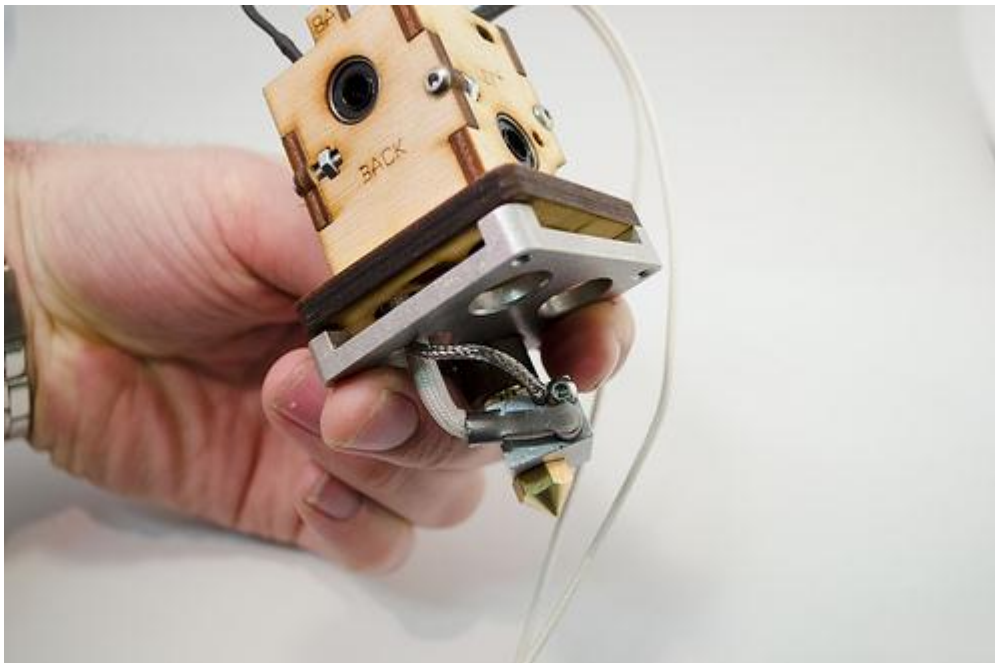
9. Take the 2 ends of the Thermocouple and the cartridge heater on the wooden 8B side and stick them through the aluminum plate, through the hole behind the PEEK.



10. Now put the Thermocouple and the Cartridge heater in the Aluminum heater block in the designated opening. Make sure they are all the way in the Aluminum heater block and do not touch each other like in the picture. The cartridge heater should be stick out a little bit on the other side.

**CAUTION**

**You should put the thermocouple and cartridge heater in the back of the heater block. Up until this point you can rotate the hot end freely so rotate like shown on the picture. The picture is showing the back of the hot end v2.**



11. Now make sure the Cartridge heater and Thermocouple are stuck by screwing in an M3 10MM screw like on the picture.

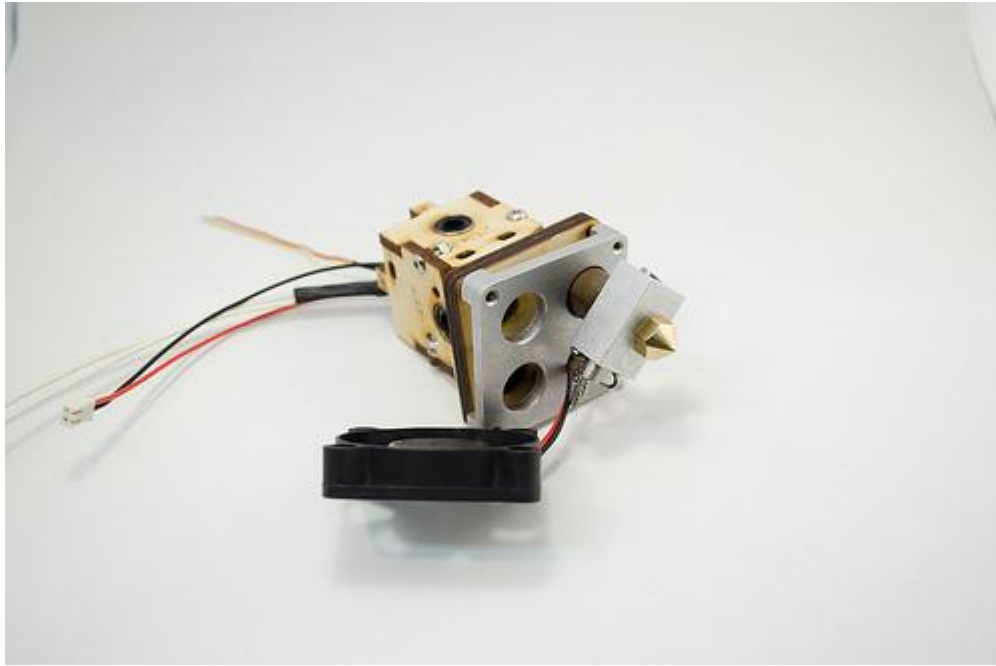
12. Put this on the side, and grab the teflon tube and the side of the bowden tube WITHOUT the blue tape. Stick this end in the teflon tube and mark your bowden tube so you will know how far it can go in.



13. Next insert the Teflon tube without the bowden tube in wooden part 8B in the front right opening, like in the picture. Put the small side in the PEEK.



14. Grab the small fan en put this wire through the same openings as the Thermocouple and the Cartridge heater.



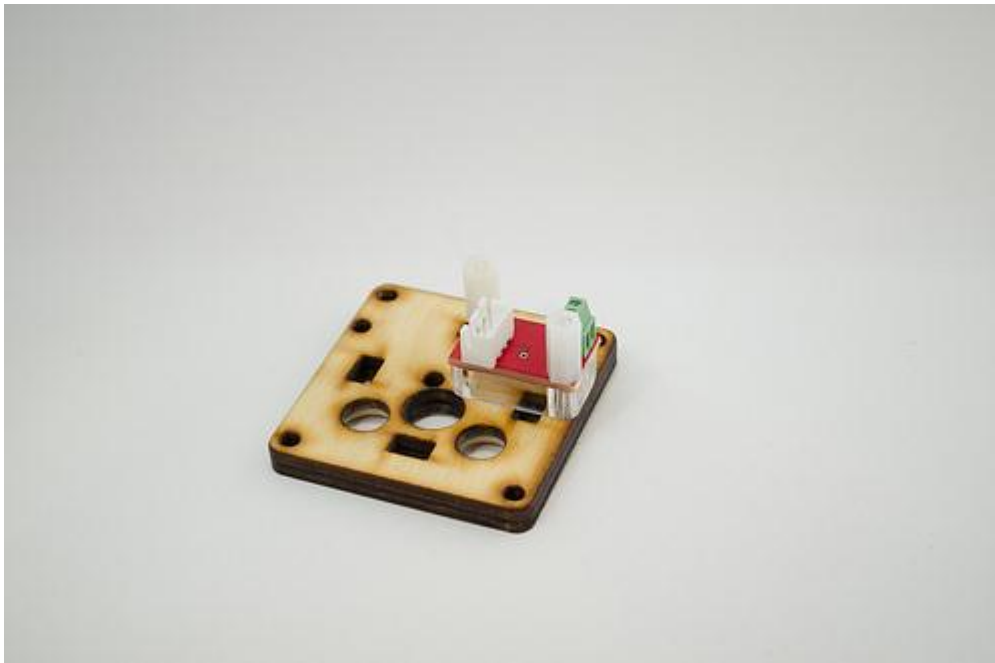
15. Put the housing aside and take 2 M3 16mm Bolts and put these in the bottom side of wooden part 8A (MILLED), and through the acrylic mounting plate. Make sure the 3 openings are aimed at the front like on the picture, and put the milled side on the table.



16. Put the Amplifier Circuit board on top of the 2 M3 16mm bolts.

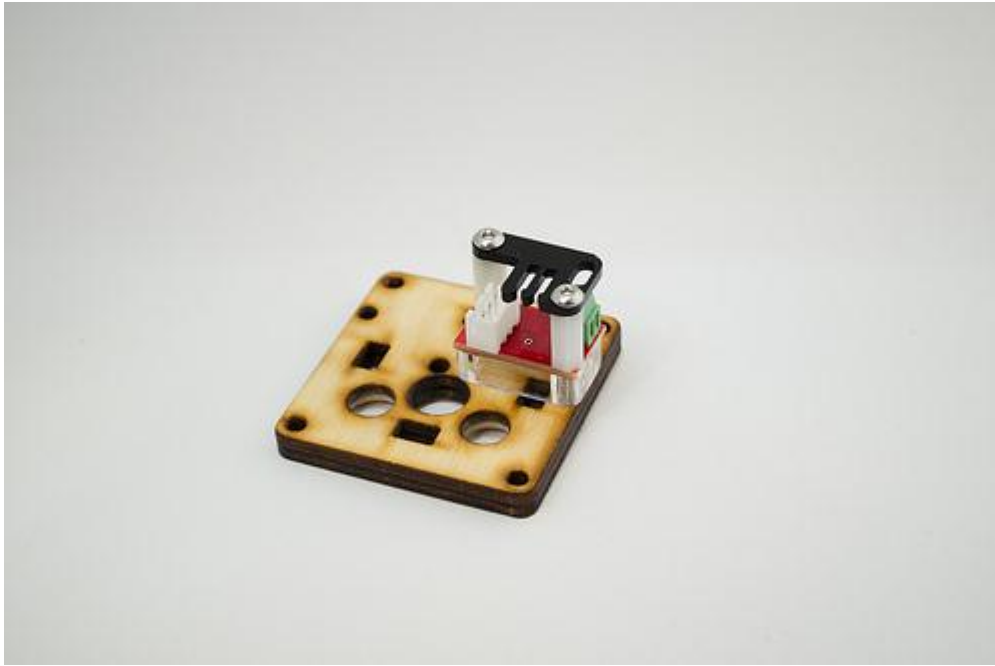


17. Put 2 threaded spacers on top of the 2 M3 16mm Bolts.



18. On top of this put the Strain relief like shown on the picture. Screw this together with 2 M3 10mm screws.

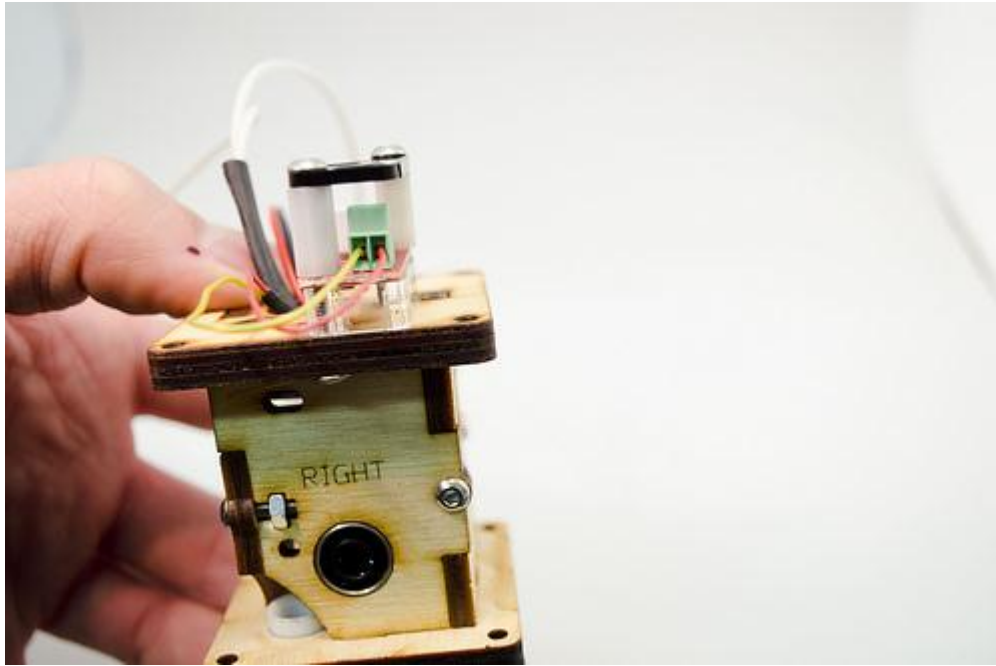




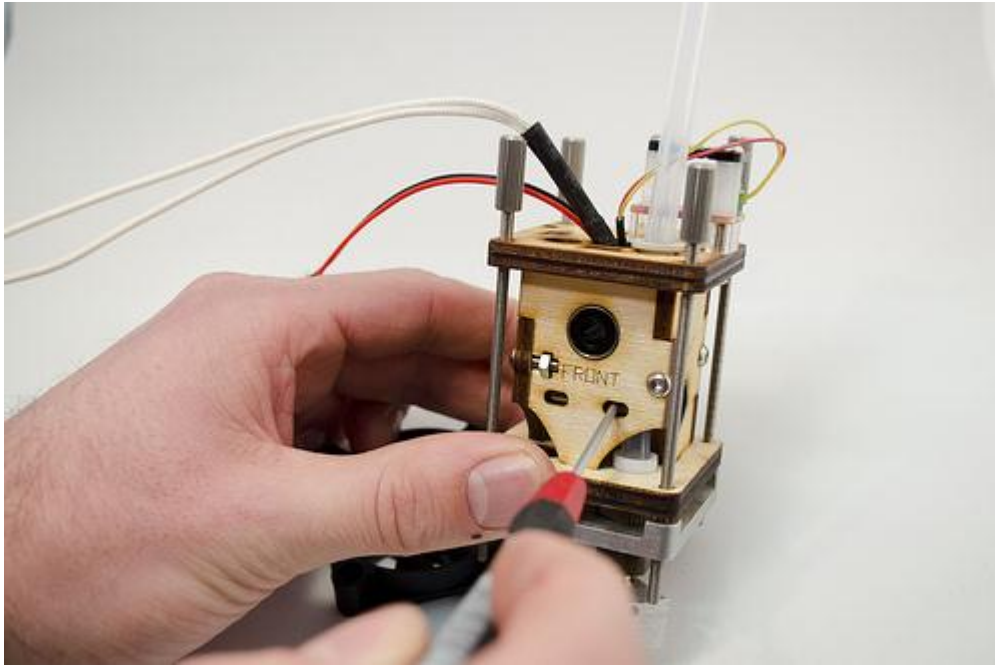
*(You can also decide to install your strain relief the other way around. The bigger opening with the screw inside should be on the left instead of the right side. This can be done as an extra security to prevent the signal cable connection to get loose and keep your hot end from overheating. Note that it is not necessary due to a build-in software safety measure. If you do want to do this, first connect the signal cable (the connection with the red dot) before screwing down the strain relief.)*

19. Now grab the 2 wires of the Cartridge heater you pulled through the housing earlier. Stick them through the opening in the middle of wooden part 8A. Keep inserting them until you come across the wires of the Thermocouple and the fan. Put these also through the hole in wooden part 8A.

20. Grab a small screwdriver and screw the red wire in the RIGHT socket, and the yellow wire in the LEFT. Like shown on the picture. If you ever upgrade your JoysMaker to dual extrusion, you need your Amplifier Circuit board to be mounted like on the picture.

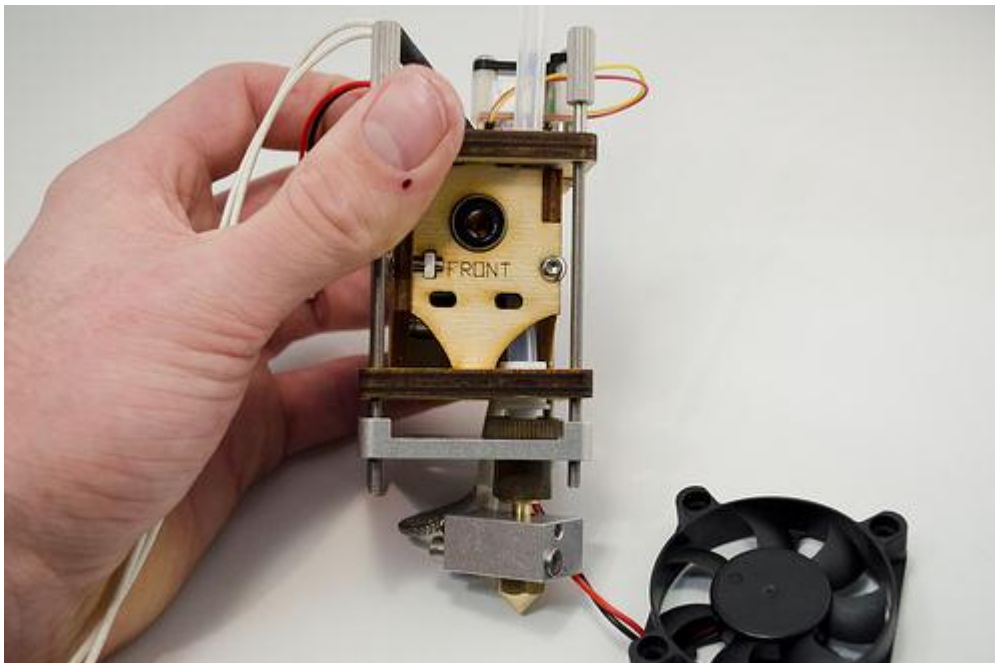


21. Take wooden part 8A and connect it on the wooden housing with the 3 holes on the FRONT.
22. Take the bowden tube clamp and put it in the front right hole. This will hold the bowden tube at it's place when it is printing.
23. Stick your bowden tube through the hole in the front right of wooden part 8A. Push it through the housing in the teflon tube. Place the teflon tube on a hard surface so you don't push it out of wooden part 8B. If necessary, use a screwdriver to push the bowden tube in its place. Grab 4 long studding screws and put them through the sockets in the corners.



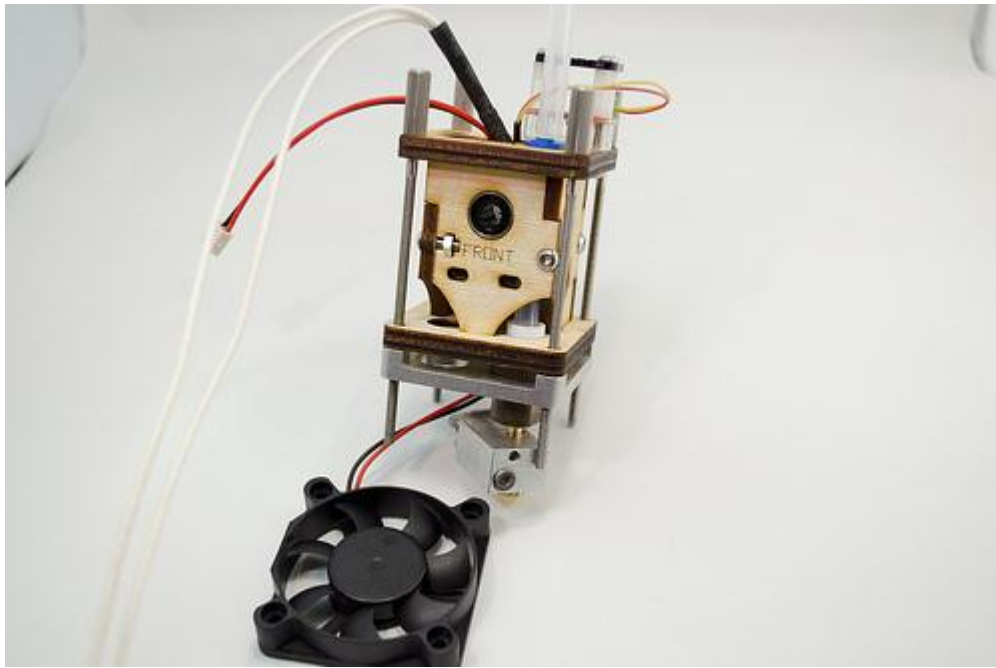
24. Pay attention to the mark you made on the bowden tube to check if it is inserted all the way through.

25. Then push the teflon tube down only 1,5mm and make sure the bowden tube is inserted again all the way. This should be done to give the bowden tube some extra pressure when the entire construction is screwed tight.



26. Put the coloured horseshoe under the tightner to lock the bowden tube.

27. Now screw everything together.



## 5.5 Assembling the cooling fan

### Parts needed in this section

Qty.	Description	Notes
1	cooling fan	Used the assemble the cooling fan.
1	black polypropylene fan duct	Used the assemble the cooling fan.
2	m3 bolts 16 mm	Used the assemble the cooling fan.
4	m3 hex nuts	Used the assemble the cooling fan.



The fan will be 'off' by default, when turning on the machine.

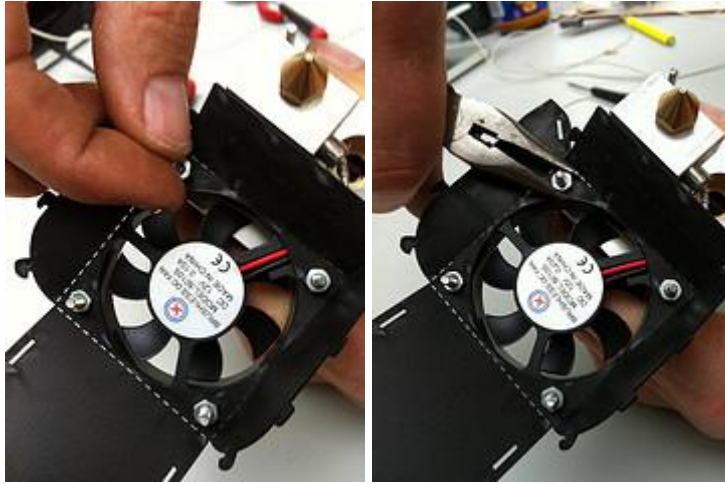
1. Fold the Polypropylene fan duct according the picture.



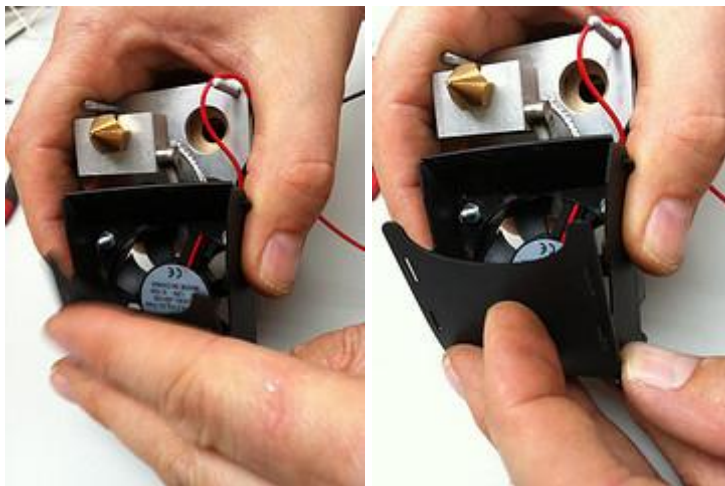
2. Take 2 16mm bolts and bolt the fan to the fanduct. Mind the orientation of the fan, the sticker on the fan should face towards the fanduct.
3. Check the picture for the orientation of the wires coming from the fan.



4. Place the fanduct on the bottom of the extruder head sticking out on the left side and bolt it together with 2 nuts on the studding.

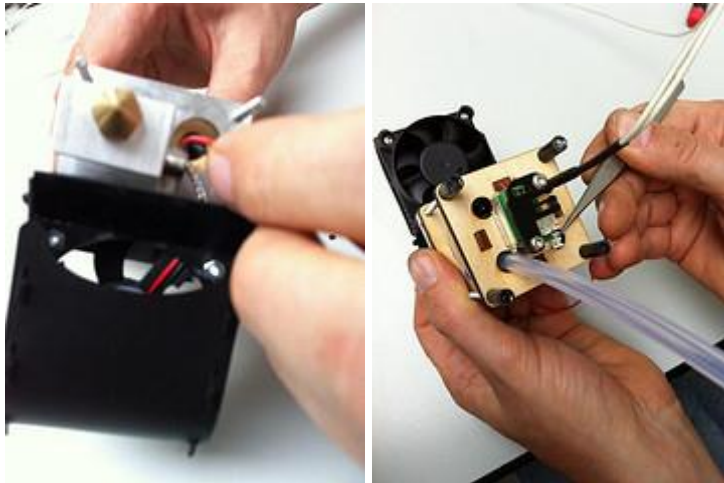


5. Fold the fanduct together.



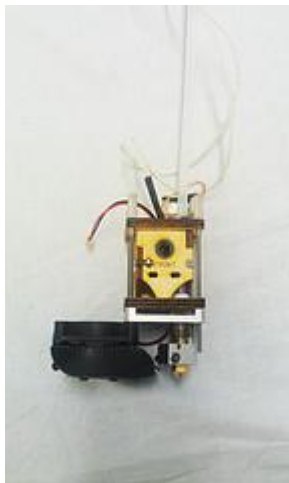
6. Guide the wire through the box. This might take some fiddling. A tweezer can be very useful.





7. When properly folded, the duct should not directly touch the extrusion nozzle or another hot element. Should you feel the need to modify the duct, ensure that airflow will not directly flow along the nozzle, since it really shouldn't be cooled too much (or you may have problems with extrusion later).

Congrats! You've just finished the most complex part of the machine!



The fan will be connected to the long black cable-assembly later (it shouldn't go onto the small circuit board).

## 5.6 Mounting the housing to the XY-frame

## 5.7 What you'll need

### Parts needed in this section

Qty.	Description	Notes
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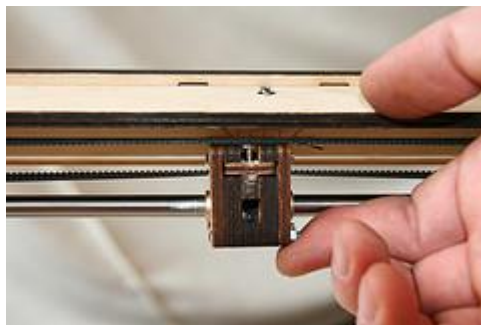


4 wooden parts named C	used for the tensioning of the belts.
2 6mm axis	sliders for the extrusion head.
4 30mm m3 bolts	used for mounting the housing of the XY frame.
4 m3 nuts	used for mounting the housing of the XY frame.



The extruder can now be placed in the XY-frame.

1. Take one of the parts C with the bolts and place it into the LEFT bushing block, but don't tighten it yet.



2. Take one of the 6mm axes and place it from left to right in the extruder head, and make sure the front of the head is to the front of the machine.



3. Take the other 6mm axis and slide it from the front to the back through the extruder head. Keep the extruder head inside the machine, below the sliding blocks.



4. Now gently push the 6mm axis on the left in its sliding block, while making sure the axes don't fall out of the head.



5. Now you can lift the axes gently into their sliding blocks.



6. Now you can place the remaining 3 part C's into their position. Before tightening these clamps, use the slackness in the belts to get the pulley screws roughly aligned so you can get at them later to tighten as pairs.



7. Finish them by putting the 30mm bolt in. DON'T tighten them yet. First clamp the 6mm axes. The clamps will also create more tension on the belts. It should not make a very high pitched sound, but it definitely should be audible, otherwise your belt is slack. Don't overdo it, be gentle!

8. Now tighten all the bolts in the sliding blocks.

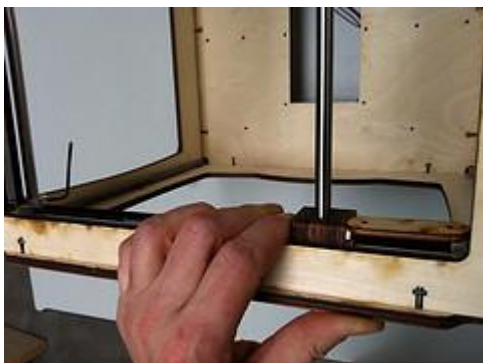


9. Now the extruder is in place, but the X and Y axes need to be adjusted so they are square towards each other.

10. loosen ALL 8 tightening screws (only the ones that are on a long timing belt) of the pulleys then adjusted the squareness of the extruder axes and tighten the screws again.



**Making sure can best be done by using part 3B and hold it between the sliding block and the frame.**





**Make sure the timing pulley does not move on the axis after the screw has been tightened. Clean the timing pulley if something is jamming the screw.**

11. Do this on both sides of one axes, tighten the screws and do it for the other axis.





**Do this properly, otherwise the mechanism will need too much force to move well.**

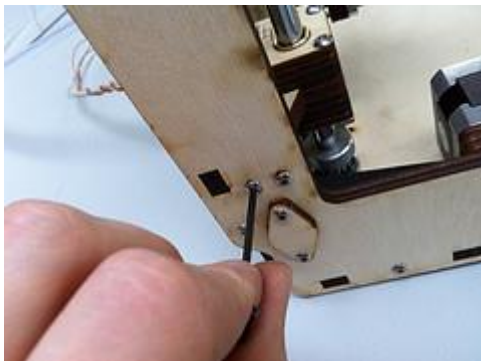
12. When this is done, the bolts of the X and Y motors can be tightened.

13. First push the motor down, so the belt has a bit tension on it. Don't overdo it. Then tighten the bolts.



Finally the X and Y limit switches can be adjusted:

14. Slide the head all the way to one end and make sure you hear the click of the switch. If not, move the switch a little until it works. Then tighten the bolts. Do this for all four of them.





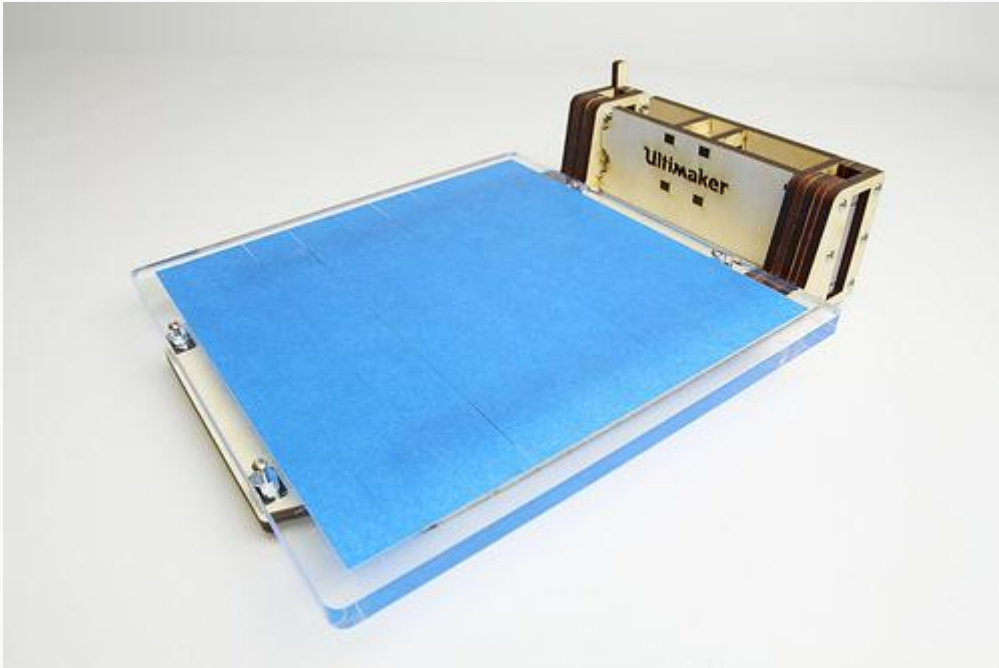
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## 5.8 Bowden cable / PFA tube

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A tube is used to guide the filament to the hot end. This mechanism is called a "Bowden Cable" (more information [here](#)). We use a PFA tube (not ordinary Teflon) for its great stability and operating characteristics. It is important that this cable is no longer than needed for the print head to move across the entire build surface.

## 6 Z-stage



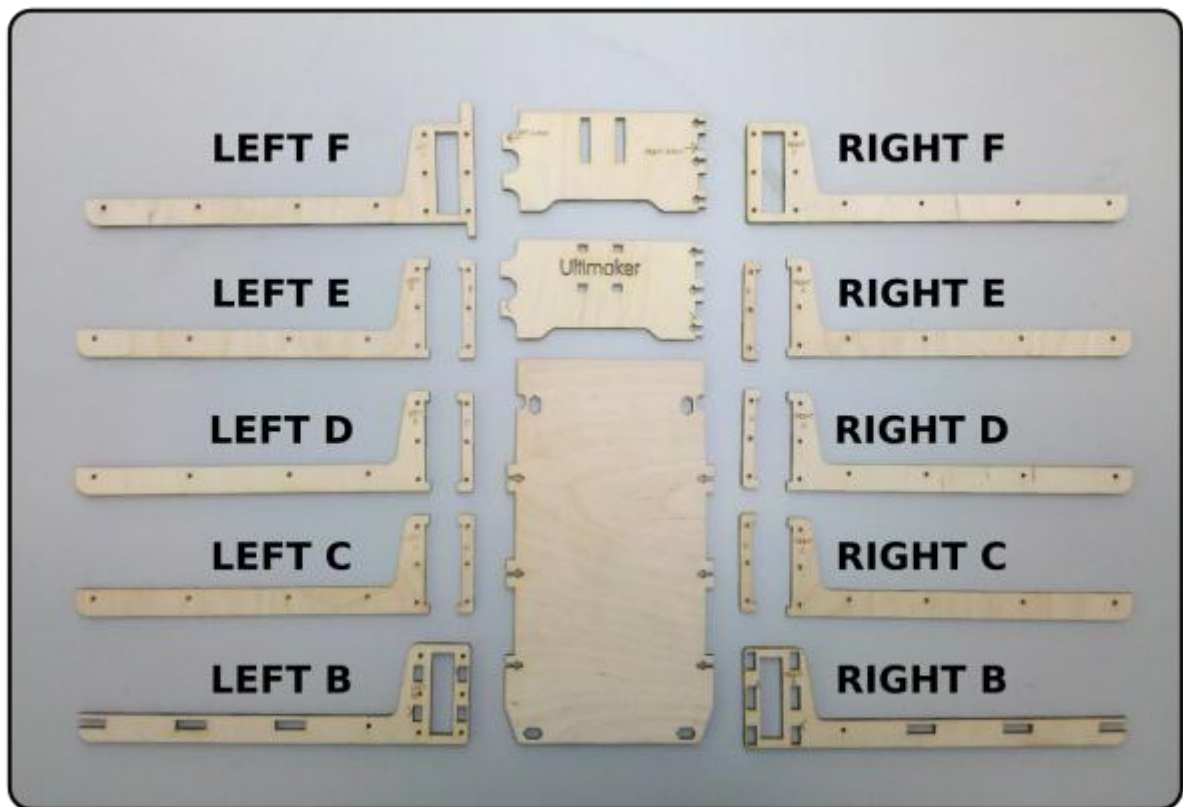
The Z-stage

### 6.1 Requirements



**Time needed:**  
60 to 90 minutes

Take the parts as depicted in the picture below:



Where left is YOUR left, not the machine's left...

## 6.2 Drive nut assembly

Parts you'll need:

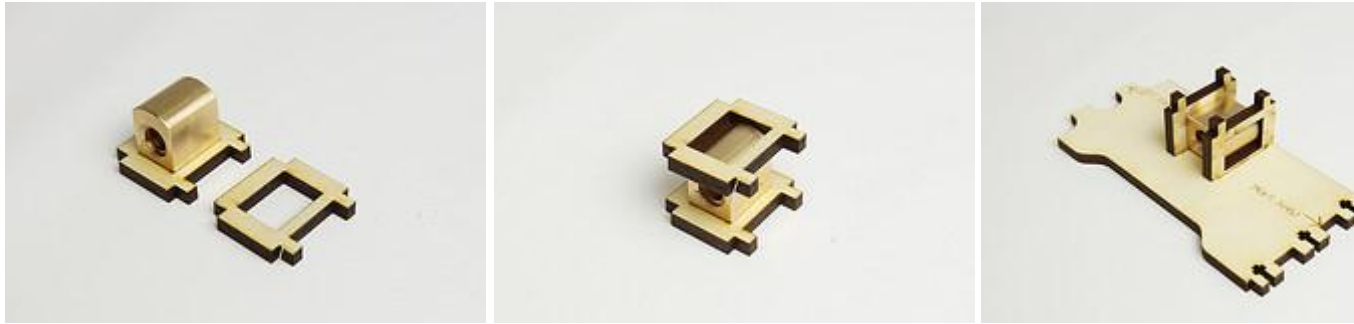


Find the drive nut in the box with the axes, screwed onto the end of the trapezoid lead screw.

**Step 1**

**Step 2**

**Step 3**

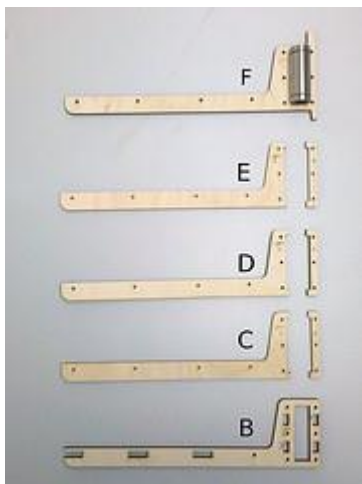


Notice that the JoysMaker text faces outwards and that the other piece has the "left side" and "right side" etching facing in. Also, each of these two pieces has 2 tabs on the left which fit into the left arm and 3 tabs on the right side, which fit into the right arm.

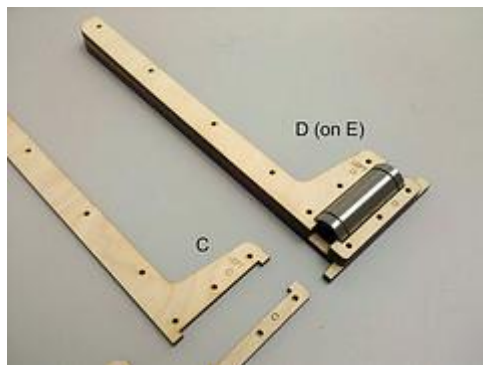
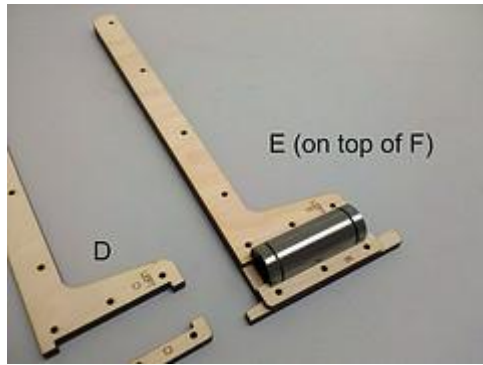


### 6.3 Left side arm

Below are all the parts you need for one of the arms of the Z-platform. Take part F (letter facing upward) and place one of the 2 large linear bearings inside.



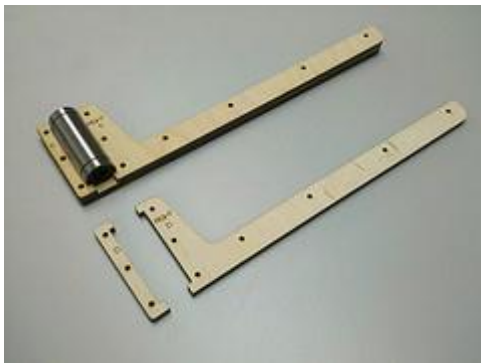
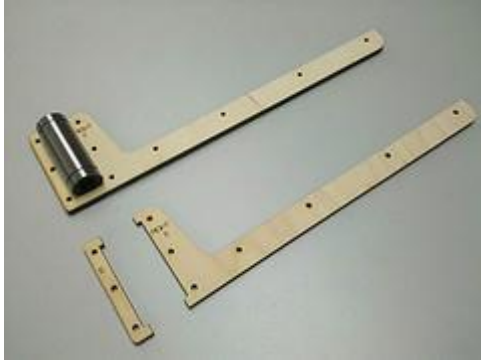
Then place part E on top of it, then part 4D, 4C, and finally part 4B.



## 6.4 Right side arm

---

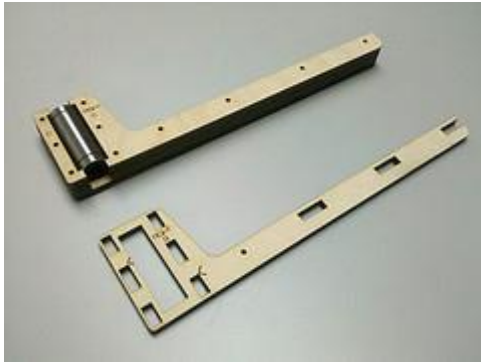
Do the same for the right arm parts. Start with part F, place the bearing inside. Now place part E on top of it, followed by D, C and finally B.



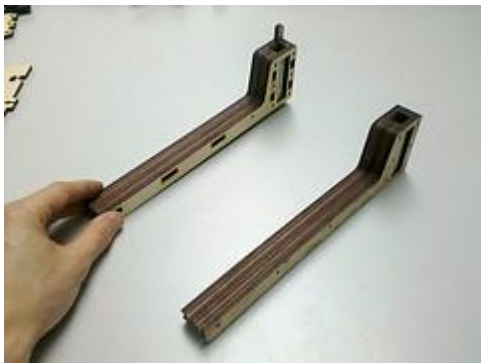
---

Finally, place B on the stack. Press firmly to make sure that the bearing is securely in the stack. You may need some force to do this.



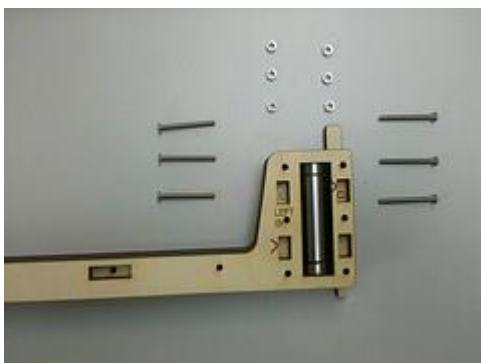


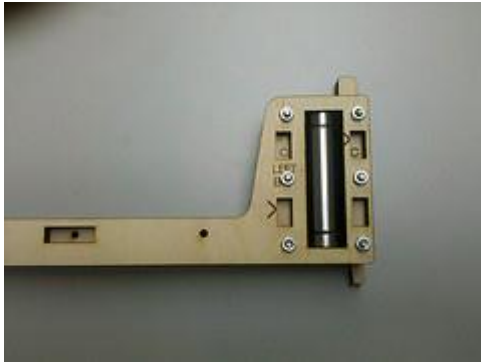
This is what the two arms should look like:



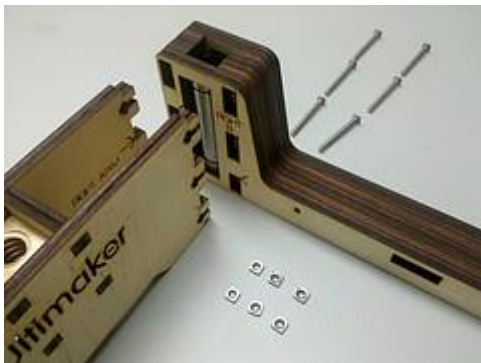
## 6.5 Putting it all together

Use 6x 30mm bolts and hex nuts to hold the left arm together.



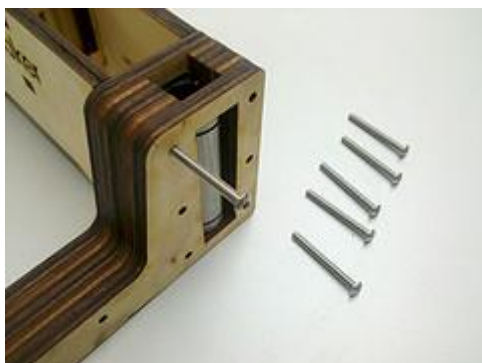
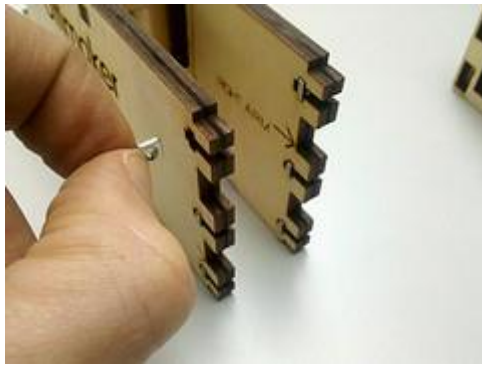


Use 6x 30mm bolts and hex nuts to connect the right arm to the center piece.

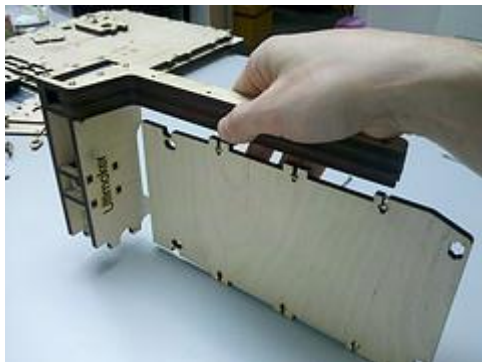
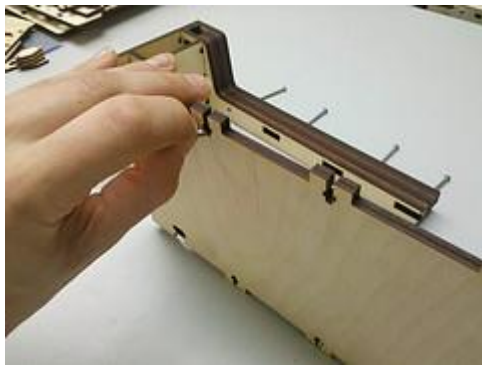
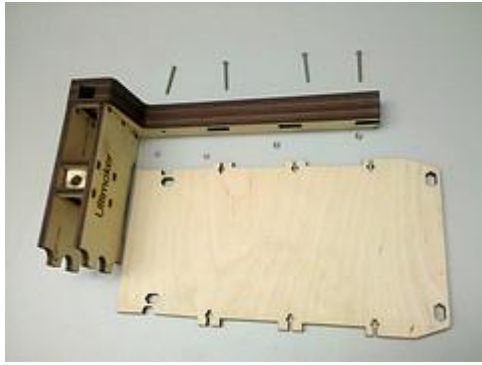


Note that the > and < symbols should match up:





Use 4x 30mm bolts, 4x hex nut to connect the right arm to the flat center piece. 3 Hex nuts go on the t-slots and one hex nut goes on the bolt closest to the back/center piece.



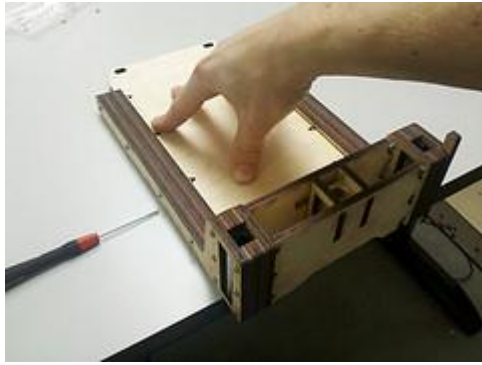
Just like the right arm, use 4x 30mm bolts, 3x hex nuts and 1x hex nut to connect the left arm to the flat center piece. 3 Hex nuts go on the t-slots and one hex nut goes on the bolt closest to the back/center piece.



With your finger, keep the nut from falling out while you insert the bolt.



Before fastening the bolts, make sure that you hold down the assembly on a flat surface. This way the platform will also be flat when you tighten everything. You have to put it at the side of the table because one of the arms has a part sticking out (that triggers the Z limit switch).



One by one, tighten every bolt on the side.



## 6.6 Inserting the adjustable leveling screws

A set of spring loaded washers push the bed up a certain amount, that is adjustable by turning a bolt up or down into black/white Delrin parts.

Please use four 30mm screws with the springs, and eight 10mm screws with hex-bolts for fixing the Delrin thingies.

Insert the Delrin parts as follows (*Note: the Delrin parts have a molding seam and will fit much easier one way than the other*):





**Make sure that the screws fits TIGHTEN in the Delrin parts and that its NOT loose. If it is loose check out the video bellow.**





## 6.7 Preparing the bed for its first print

Remove the protection foil from both sides of the acrylic and put blue tape on the top surface, starting next to the first line that is engraved into the acrylic.



Then run a knife along the length of the groove that is laser cut into the acrylic. Then you can remove the excess parts of tape and get a really tidy print-bed:



Finally, mount the acrylic print platform by guiding the four bolt heads through the holes in the acrylic. Then slide it sideways while pushing it down slightly.



You can do this mostly with one hand, by grabbing the lower rim of the left arm with your fingers (pinky to index finger) and your thumb against the acrylic. Then, squeeze your hand and you will slide it in place. You can do the same with your right hand on the right side to release the bed.

## 6.8 Installing it in the machine



**While the pictures are of an older revision of the Z-stage, the instructions remain the same.**

Now the Z-STAGE can be mounted inside the machine. Place it on the bottom, take one of the 12mm thick axes, and slide it through the top of the machine all the way down, through the linear bearing, and push it gently into the bottom hole.



Slide the platform a little up and push the axle gently in the bottom hole.



Do the same for the other 12mm axes.



Finally you can place part 3B with 16mm bolts to the top, so the axes cannot slide out anymore.



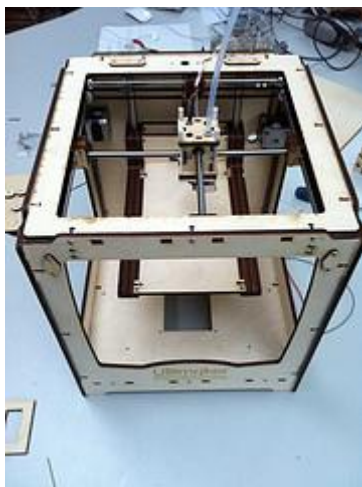
Now take the M8 thread and place it from the top into the machine. Screw it into the nut that is enclosed in the Z-stage and rotate it until it protrudes at the bottom of the z-stage.



Now you can fix it into the coupling at the bottom by tightening the little set screws. You need a smaller size Allen key than is currently provided with the machine.



The frame is now ready.



### 6.8.1 Grease it up

Put a droplet of the supplied tube of grease on your finger and spread it across the the \*leadscrew\* by running your finger along its length. Don't grease up any other rods. Later, when moving the Z axis, the nut will spread it around. You can turn it by hand now, or let the machine turn it by itself. The volume to add could be less than 0.5 cubic centimeter, e.g. about the volume of a piece of Sportlife gum.



## 7 Material feed mechanism

### 7.1 Contents

[\[hide\]](#)

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- [1.1 Parts needed in this section](#)

#### [2 Step 1: Assembly of the main body of the drive mechanism](#)

- [2.1 Parts needed in this section](#)

#### [3 Step 2: Drive bolt assembly](#)

- [3.1 Parts needed in this section](#)

#### [4 Step 3: Assembling the clamp](#)

#### [5 What you'll need](#)

- [5.1 Parts needed in this section](#)

#### [6 Step 4: Mounting it to the machine](#)

#### [7 Step 5: Filament holder](#)

- [7.1 Parts needed in this section](#)

[8 Questions or comments regarding this page? Let us and others know!](#)

[Click here for a detailed photo series of the construction on our flickr account.](#)

The finished assembly should look like this:



### 7.2 What you'll need



#### **Time needed:**

30-40 minutes (please also report how long it took in the comments)

**Tools needed:**

- Hex key / driver (2.0mm)
- An adjustable wrench (that fits M8 nuts or pliers)

**Parts needed in this section**

Qty.	Description	Notes
1	Stepper motor	Use the one with the flat part for the small black gear
1	Quick fit coupling	The grey part, used to fit the Bowden tube
2	Bearings	Sealed ball bearings with 8mm inner diameter
1	Small gear	A black gear made of Delrin, find it on one of your stepper motors
1	Large gear	The large wooden gear
1	Hobbed bolt	This is a bolt with grooves that is used for driving the filament
3	8mm bushing/washer	Bushings (or "washers" if you're in the US) used as spacers
12	M3x20 bolts	These are grouped in a bag
1	M3x25 bolts	For the tensioner. These are grouped in a bag
9	Locking M3 nuts	These are special nuts that do not loosen themselves (see picture)
1	Wooden part 10A	Grouped in a bag
1	Wooden part 10b	Grouped in a bag
1	Wooden part 10C	Grouped in a bag
1	Wooden Gear	Named extruder
	Laser cut parts (Delrin)	These are grouped in a bag

## 7.3 Step 1: Assembly of the main body of the drive mechanism

**Parts needed in this section**

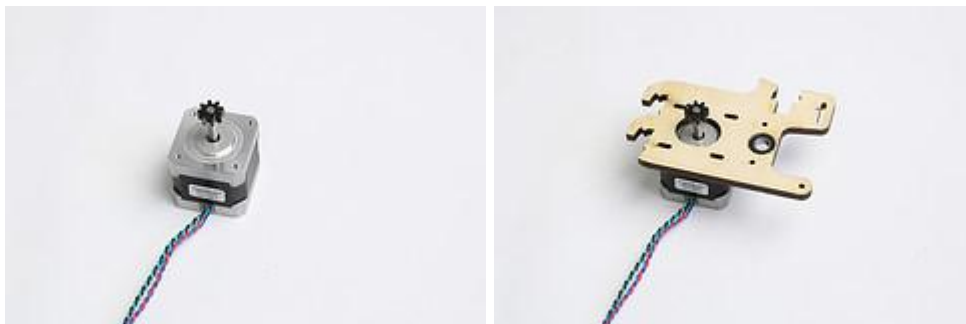
Qty.	Description	Notes
------	-------------	-------

1 Stepper motor	Use the one with the flat part for the small black gear
1 Wooden part 10A	Grouped in a bag
1 Wooden part 10b	Grouped in a bag
1 Wooden part 10C	Grouped in a bag
1 Wooden gear	Named extruder
2 Ball bearings 8mm	Used in 10A and 10C
1 Quick fit coupling	
6 20 mm bolts M3	
2 Lock nuts M3	

1. Take part 10A and 10C and place the 2 bearings in the corresponding holes.



2. Take the motor with the delrin gear and place part 10A on top of the motor, with the engraving (10A) facing towards the motor.



3. Take part 10B and place it on top of part 10A.



4. Put the quick fit coupling in the T-slot.



5. Place part 10C on top of part 10B.



6. Take 6 20mm bolts and 2 nuts. Use 4 bolts to mount the motor to the parts, but don't bolt them tight. The motor needs to be adjusted later. Use the other 2 bolts and nuts to bolt the parts together. These can be tightened normally. If it's not already there, push the small gear on the motor axis, just until the axis is on the same level as the front of the small gear. Don't push it further.



7. Take 2 20mm bolts and push them through the holes next to the bearings and tighten them with 2 lock nuts.



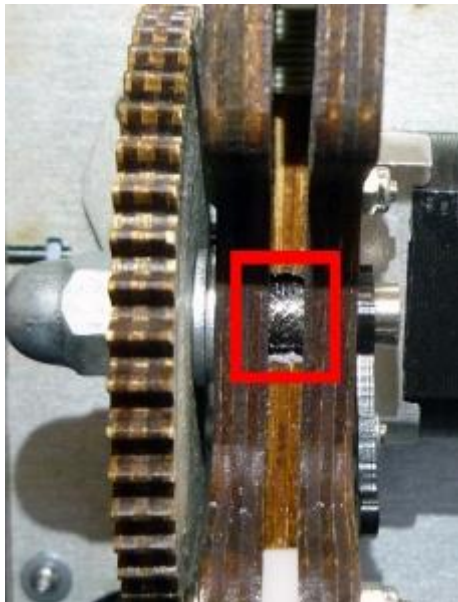
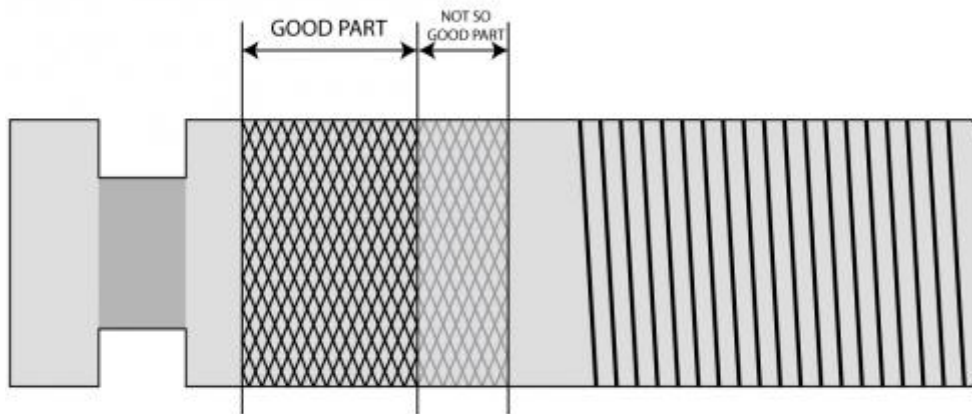
## 7.4 Step 2: Drive bolt assembly

This section is written for the new drive bolt ('version 3'), for the old assembly instructions see [Drive bolt v2 assembly](#)

### Parts needed in this section

Qty.	Description	Notes
1	Big wooden gear	
1	M8 nut	
1	Drive bolt	
3	Washers	
1	Delrin clip	Small, black part
1	M8 cap nut	

1. Take the drive bolt and click the delrin clip on the groove. Slide it from the motor side in the bearings, so it protrudes on the other side. The 'good' gripping part -nearest to the end - should be straight between the two housing plates. If it isn't, check if you bolted the mounting plates tight enough (but not too tight!).



2. Take the big gear and put the M8 nut inside.



3. place two 8mm washers on the *hobbed bolt* and then screw on the big gear (with the 'extrude' text on the outside). The last few turns are easier done by turning the bolt instead of the gear, because otherwise you are turning the motor as well. The washers prevent the gear from touching the bolts on the extruder



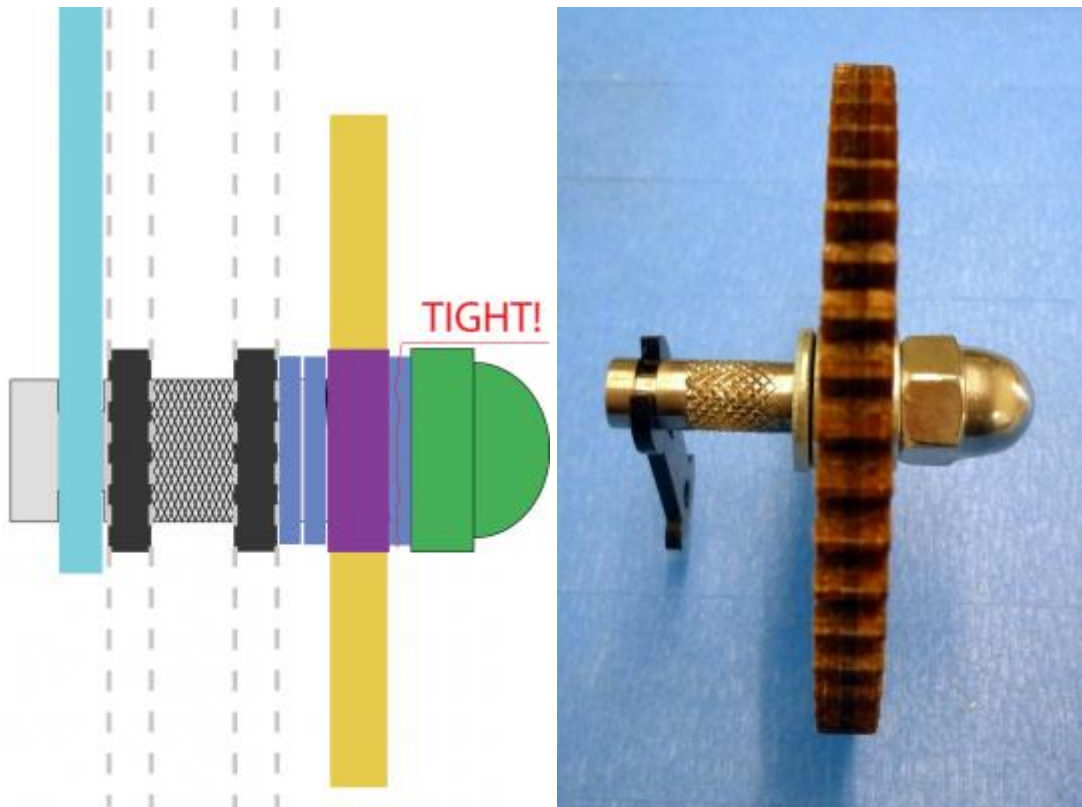
drive housing. It should not be too tight, the entire bolt and gear should be able to turn freely in the bearings. Only one washer is shown on the picture.



4. Place a washer next to the gear and then loosely put the (cap) nut on the bolt
5. Tighten the gear and (cap) nut on each other (with the washer in between) If it is still possible to rotate the gear while the bolt is still, you might need to put another washer between the (cap) nut and the gear. Tighten the *two NUTS together*, do not put the nuts tight onto the hobbled bolt. Withouth filament, the only friction you should feel is the motor. It is important that the bearings are not clamped together. There should be a little void/play between the gear-nut and the washers.



The final assembly should have the following order:



- Turquoise = Delrin clip
- Dark grey = Bearing (in extruder housing);
- Blue = M8 washer;
- Purple = M8 hex nut;
- Yellow = Wooden extruder gear;
- Green = Cap nut.

## 7.5 Step 3: Assembling the clamp



The Extruder Drive Upgrade is a derivative of the design of [Bertho's on thingiverse](#). It has quite a few benefits over the old one. The facts on the design:

1. Retrofit - fits on all Ultimaker/JoysMaker printers.
2. Spring design - compensate for diameter differences in PLA.
3. The snap system - locks the extruder driver in place, so no more adjusting the screw.
4. Retraction - this design results in significantly better retraction.
5. Easy assembly - you only have to replace a small part of the extruder not the whole extruder unit.
6. Noise reduction



**Time needed:**  
About 30 to 40 minutes.

## 7.6 What you'll need

### Parts needed in this section

Qty.	Description	Image
1	30mm M3 bolt	

3 25mm M3 bolt

2 20mm M3 bolt

4 16mm M3 bolt

1 nut M3

9 lock nut M3

1 ball bearing 8mm



1 washer M3

1 extruder drive spring



1 push wheel (delrin)



1 extruder mounting plate (delrin)



1 lever (delrin)



1 bracket middle piece (printed)



1 10.1A (4mm plywood)



1 10.1C (4mm plywood)

2 10D (4mm plywood)





**Some pictures may show the whole feeding mechanism disconnected from the Printer, but there is no need to do that when you're replacing the upgrade.**

If you are upgrading your current printer, first do the following:

Use the screwdriver (m3 hex) to unscrew the bolt that holds your old feeding mechanism in the feeder and take out the Delrin lever as well.



1. Let's start building the new feeding mechanism. First push the ball bearing in the Delrin wheel. This might require some force, use a piece of plywood to make it easier to push the ball bearing.



+



=



2. Put a nut in the Delrin Mounting plate at the T-slot. Pay attention that the nut is placed like in the picture. This will make it easier when you have to put the screw in on a later stage.



3. Take wooden part 10.1 A and 10.1 C and the Delrin mounting plate. Put them together using 4 16mm M3 bolts and 4 lock nuts. The engraved letters should be facing inwards. Make sure the screws enter via the non-engraved side of the 10.1 C wooden part.







Now screw it together with 4 nylock nuts.

4. Next take 2 25mm M3 bolts, 2 lock nuts, the plastic bracket middle piece and the 2 remaining wooden parts. Put them together as shown in the picture below.



When assembled, the bracket piece can be sticking out partly. You might need to use some, no excessive, force to put it in its place. Make sure it is leveled with the wooden parts.



This part should easily fit over the other part you assembled in step 1-4.

5. Take the 25mm M3 Bolt and the delrin push wheel. Insert the push wheel between the wooden parts 10.1 A and 10.1.C. It fits right into the opening in the delrin mounting plate. The bolt you use might seem to long at first, but actually it

isn't. Stick it through the wooden parts and the wheel, but don't fully tighten it. The parts should freely slide over each other.



Then grab the assembled part with the bracket piece, and shove it over the other part. It should fit right over the bolt. Now you can firmly tighten the lock nut. The wheel should have a little bit of room for movement and rotating. The assembled part should be able to move back and forth without friction.



6. Put a spring and a washer over the 30mm M3 bolt and screw this in the back of the upgrade you have assembled so far. The nut you placed earlier in the delrin mounting plate should hold the screw in its place. But it still requires some force because you have to push the spring and screw the bolt at the same time. If you didn't put the nut in like shown in the picture this might be difficult.

If you think you inserted the nut correctly but are still having problems getting the bolt in, try removing the spring and reassembling with the bolt barely started into the nut. You can then compare the how far out the bolt is to the length of the spring so you have a better idea of how much you need to compress the spring - it will be about 2-3mm. Reassemble with the spring and try again.



You now have completed the feeding mechanism! Congratulations. Let's attach it to your printer.

7. If you already removed your old feeding mechanism you can put this new one in place of the old one. Use the remaining 20mm M3 bolt to connect them both. Do not screw it on too tight, because it needs to be able to move. Make sure, like with all other components, that the nuts face **AWAY** from the wooden gear.



8. You are almost finished, just one step remaining. Since you also have removed the old lever, you need to replace it with the new one. Notice the difference between the new and the old lever, the new one is flatter and has only three teeth



per side.

It might look like the old one, but it designed so it locks down. Place it in a way that the flat side is facing up, when the lever is pushed down.



Great! You just finished upgrading your printer to the next level.

## 7.7 Step 4: Mounting it to the machine

You can mount it to the frame by sliding it into the slots at the back of the machine (top left when viewed from the back of the machine). The slots in the middle of the back plate are for the filament holder.

Put the wires through the hole and through the kite fabric.

Guide the cables from the extrusion head through the hole at the back and through the cable duct on the inside. Also wrap the wires from the extruder motor or use a separate piece of coil wrapping.



## 7.8 Step 5: Filament holder

### Parts needed in this section

Qty.	Description	Notes
2	Wooden parts 11B	Use the one with the flat part for the small black gear

4 Wooden parts 11C Grouped in a bag
-------------------------------------



1. Take the two parts 11B and place them next to each other.
2. Put the parts 11C in the corresponding slots of the parts 11B.



3. Place the filament holder in the slots at the back of the machine.



## 8 Mounting the electronics

### 8.1 Step 1: What you'll need


**Time needed:**

About 30 to 60 minutes.


**Tools needed:**

- Hex keys (2mm)
- Tiny flat screw driver

### Parts needed in this section

Qty.	Description	Notes
5	Socket cap M3 bolts 12mm	Used for installing the electronics.
6	Socket cap M3 bolts 30mm	Used for installing the electronics.
4	Socket cap M3 bolts 10mm	Used for installing the electronics.
7	Hexagonal M3 nuts	Used for installing the electronics.
4	Threaded spacers	White hex squared (color can vary).
4	Tube spacers	White round tubes(color can vary).
1	Circuit board	Green electronic board.
1	Cooling Fan	The big one in the <a href="#">fan pack</a> .
1	Cooling duct sheet	Flat plastic in the <a href="#">fan pack</a> .
1	Wooden panel fan	Flat plastic in the <a href="#">fan pack</a> .
1	Wooden electronic panel	Long squared with a hole for mounting the big fan.
1	Wooden cover panel	Named "POWER OFF WHEN REMOVED".
1	Blue scotch tape	The blue roll originally inside the Megapack.
1	Black electronics Cabel with 3 tiny	This one you need to mount between circuit



plugs on both sides

board and extruder head.

**About the electronics**

The electronics simply need to be mounted to the machine and a few wire connectors plugged in. For extra safety, there's also a cooling system under the electronics that will reduce the chance of problems. The stepper drivers can get hot, and if they would overheat, a thermal fuse will turn them off. The cooling system will allow the machine to work in a warm environment or allow you to set the current slightly higher than usual.



**When handling electronics make sure that you are not statically charged. This can permanently damage your electronics.**

## 8.2 Step 2: Installing the electronics

### Needed in this step

Qty.	Description	Notes
4	Socket cap M3 bolts 30mm	Used for installing the electronics.
4	Threaded spacers	White hex squared (color can vary).
4	Tube spacers	White round tubes(color can vary).
1	Circuit board	Green electronic board.



1. On the BOTTOM plate put the 30mm bolts from INSIDE toward OUTSIDE.
2. Put the Tube spacer on the 30mm bolts
3. Put the green circuit board on the 4 bolts.
4. Secure the circuit board on the bolts with the threaded spacers.

Before completely tightening the white threaded spacers, you can slide the bolts through their slots to decide how much you want to put the electronics towards the side of the machine. Fixate the circuit board by tightening the threaded spacers.



### 8.3 Step 3: Preparing the electronics cooling system



**Get ready for some serious origami!**

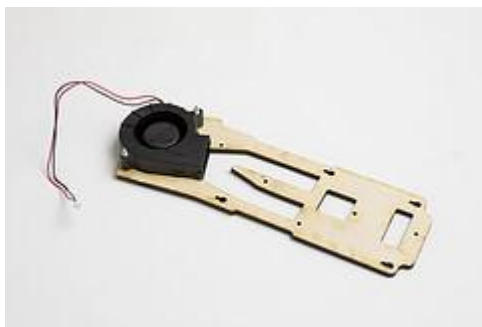
### Needed in this step

Qty.	Description	Notes
1	Cooling Fan	The big one in the <a href="#">fan pack</a> .
1	Cooling duct sheet	Flat plastic in the <a href="#">fan pack</a> .
1	Wooden panel fan	Flat plastic in the <a href="#">fan pack</a> .
1	Wooden electronic panel	Long squared with a hole for mounting the big fan.
1	Wooden cover panel	Named "POWER OFF WHEN REMOVED".
1	Blue scotch tape	The blue roll originally inside the Megapack.
5	Socket cap M3 bolts 12mm	Used for installing the electronics.
2	Socket cap M3 bolts 30mm	Used for installing the electronics.
7	Hexagonal M3 nuts	Used for installing the electronics.

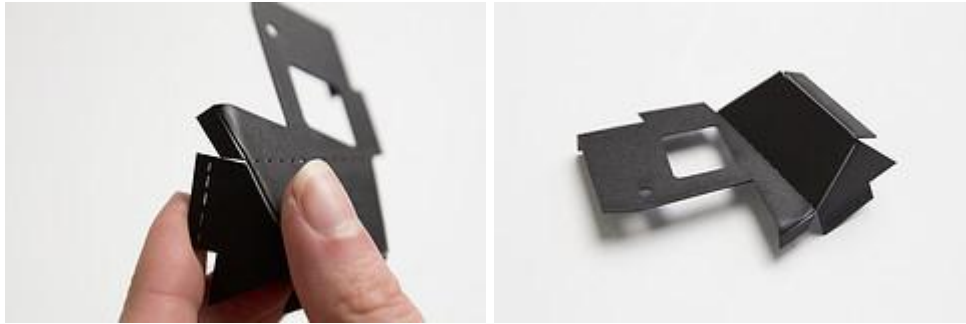
You'll be working with the following parts:



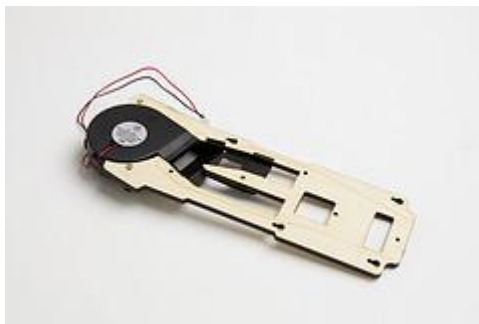
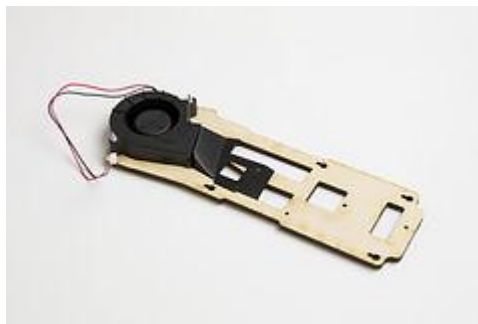
1. Mount the fan to the side that is not marked. Use two 30mm bolts and two nuts.



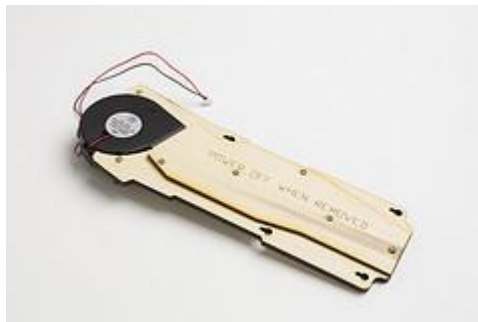
2. Take the cooling duct sheet and fold it along the perforations.



3. Put the cooling duct sheet over the wooden panel and fold the small tabs downwards to the other side of the panel.

**BOTTOM SIDE****TOP SIDE**

4. Continue with the bottom (engraved) side facing upwards and place the wooden air-duct cover over the openings. Fasten it with five 12mm bolts and nuts. Using short bolts is important so that the ends do not touch the electronics. Make sure that they are very tight, so that they will not get loose because of vibrations.



5. Put blue tape on the bolt ends to ensure they are isolated electrically, and the electronics cooling system assembly is finished.

**Sealing**

If needed, tape the duct sheet to the fan to prevent unwanted air leaks and to get the most air flow concentrated on the stepper chips.

Connect the fan to the (always on) 12V power output. The red wire (+ 12V) should be connected to the + side of the header. When you toggle the power switch, the fan should turn on (make sure you plug in the power supply too).



**Make sure you only have the board powered on when the cooling system is connected and in place. Otherwise parts may become very hot. Some parts have an automatic thermal shutdown, but this doesn't mean you can't burn your hand or damage other objects.**

**v1.5.4 through 1.5.7 PCB: connect it there**

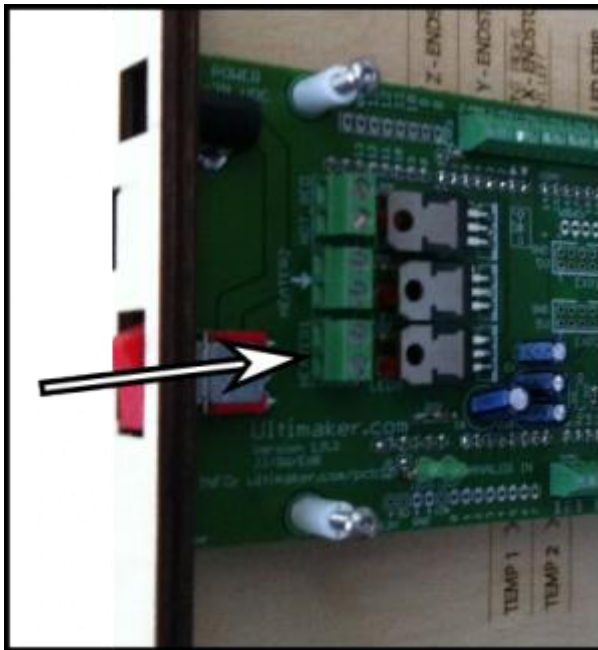


## 8.4 Step 4: Connecting the Heater



**All the cables inside the machine (printing area) should be guided through the cable ducts.**

1. Connect the white cables of the heater element to two terminals of the HEATER 1 output on the motherboard (the first of the 3 bigger green screw terminals). Make sure there's not too much wire stripped away so that the one wire touches the other.

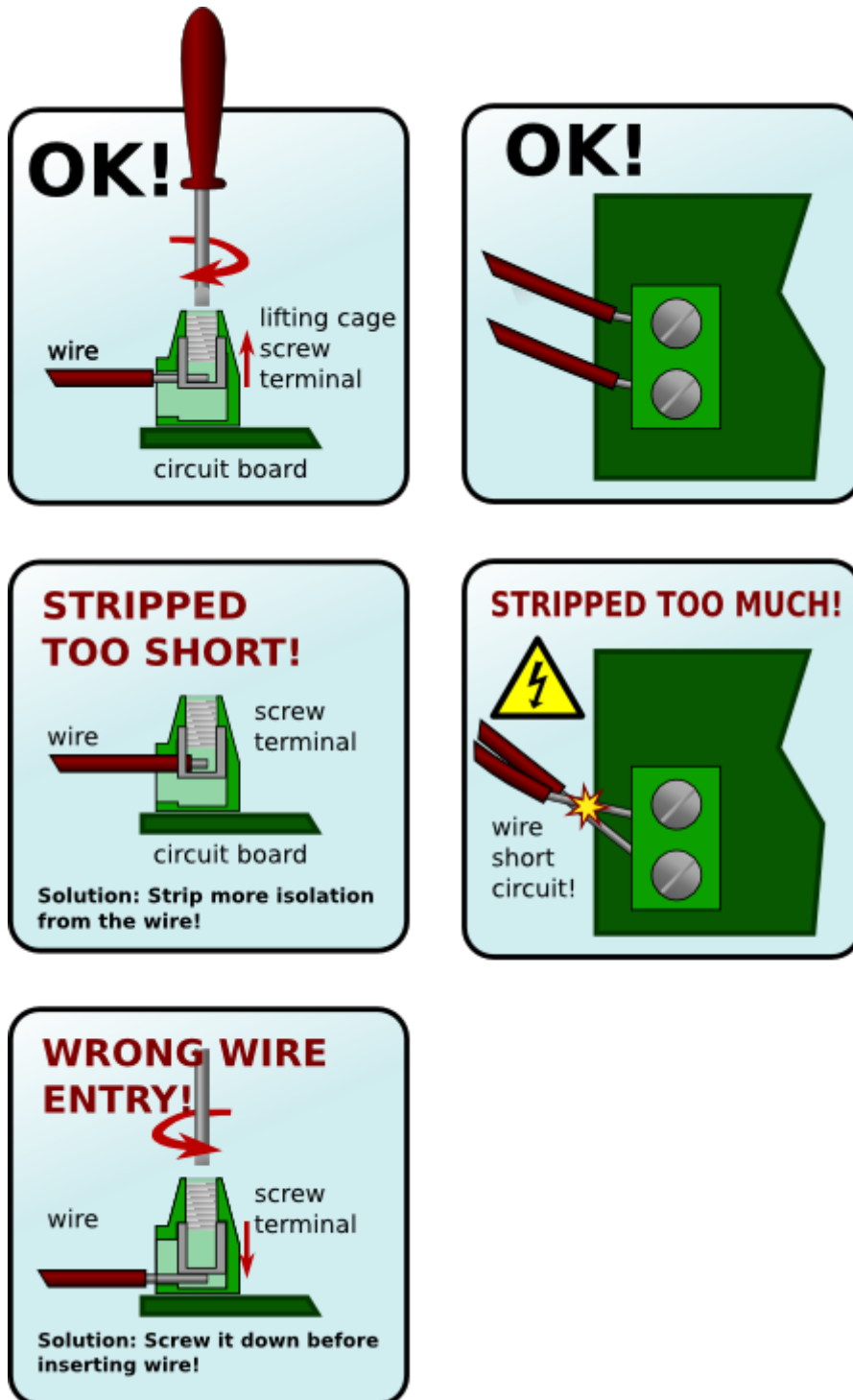


2. Use a small screwdriver to tighten the screw terminals for the heater.



**Make sure the wires are connected to the terminals in the correct way (see picture below).**





## 8.5 Step 5: Connecting the printhead electronics

### Needed in this step

Qty.	Description	Notes
1	Black electronics cable with 3 tiny	This one you need to mount between circuit

plugs on both sides

board and extruder head.



The black electronics cable with the 3 tiny plugs on both sides will be used for connecting the circuit board with the extruder head

1. Maneuver the 3 tiny plugs of the black through RIGHT BACK corner of the machine.



**The side with the smaller plugs should be at the print head.**

2. Then follow up with guiding the cable through the cable duct and out through the hole in the BACK (below the motor).
3. Now you are able to connect the plugs to the printhead.
4. Plug the RED/BLACK connector of the extruder head in the BLUE/PURPLE connector of the black cable.
5. Plug the RED/BLACK/YELLOW connector (with the dot) on the white connector of the extruder head (tiny circuit board).
6. *OPTIONAL: plug the GREEN/ORANGE/BROWN connector on the second connector.*
7. When you are done, you are ready to connect the cables at the bottom of the machine.



#### **Positions of the connectors**

At the bottom of the machine you see engraved in the wood the position where you need to plug in the connectors.

8. Plug the BLUE/PURPLE connector on the circuit board where is says FAN PRINTHEAD.
9. Plug the RED/BLACK/YELLOW connector on the circuit board where is says TEMP1
10. Plug the GREEN/ORANGE/BROWN connector on the circuit board where is says TEMP2

## 8.6 Step 6: Connecting the rest of the cables



**To prevent problems later you need to guide all the cables through the cable ducts. Make sure that you guide the cables the shortest way down to the bottom of the machine. Any loose cables inside the machine (printing area) can cause trouble.**

1. The connect the limit switches to the circuit board where is says END STOPS.  
The limit switches each have a number (e.g. ①), listed next to the limit-switch itself and listed where the header for this limit-switch is located.

### 8.6.1 Tracing back cables limit switches

The black limit switch that is connected at the BOTTOM plate is limit switch number 1.

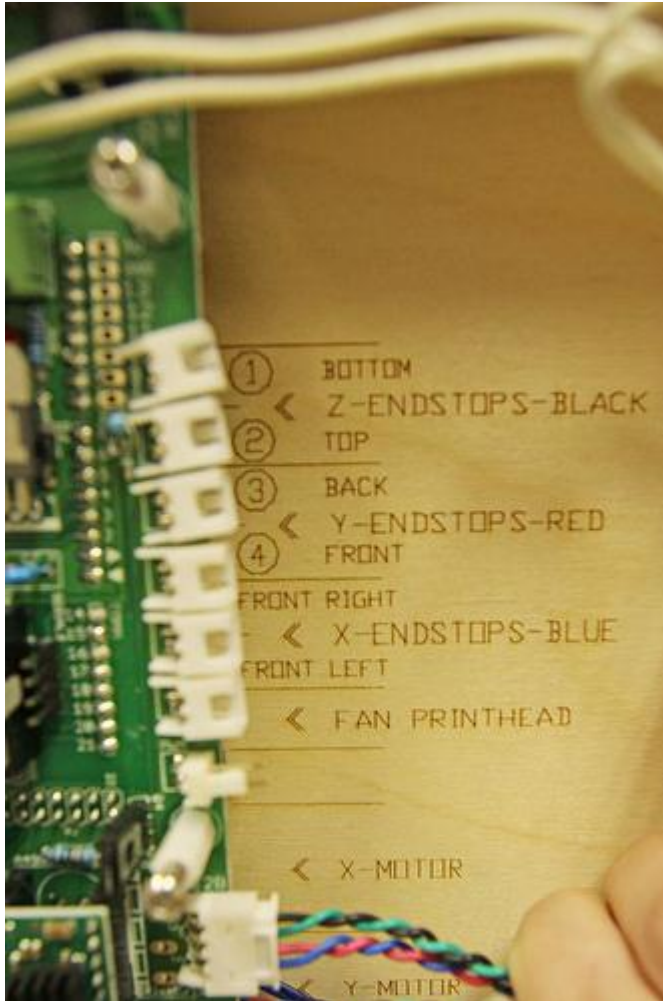
The black limit switch at the TOP of the machine is limit switch number 2.

The Red limit switch at the BACK of the machine is limit switch number 3.

The Red limit switch at the FRONT of the machine is limit switch number 4.

The Blue limit switch at the RIGHT of the machine needs to be placed where it says FRONT RIGHT.

The Blue limit switch at the LEFT of the machine needs to be placed where it says FRONT LEFT.



## 8.7 Step 7: Connecting the motor

2. You now can connect the 4 motors to their respective connections on the circuit board.

### 8.7.1 Tracking back cables motors

The X-MOTOR is connected to the BACK of the machine and needs to be connected at the circuit board where is says X-MOTOR.

The Y-MOTOR is connected to the LEFT of the machine and needs to be connected at the circuit board where is says Y-MOTOR.

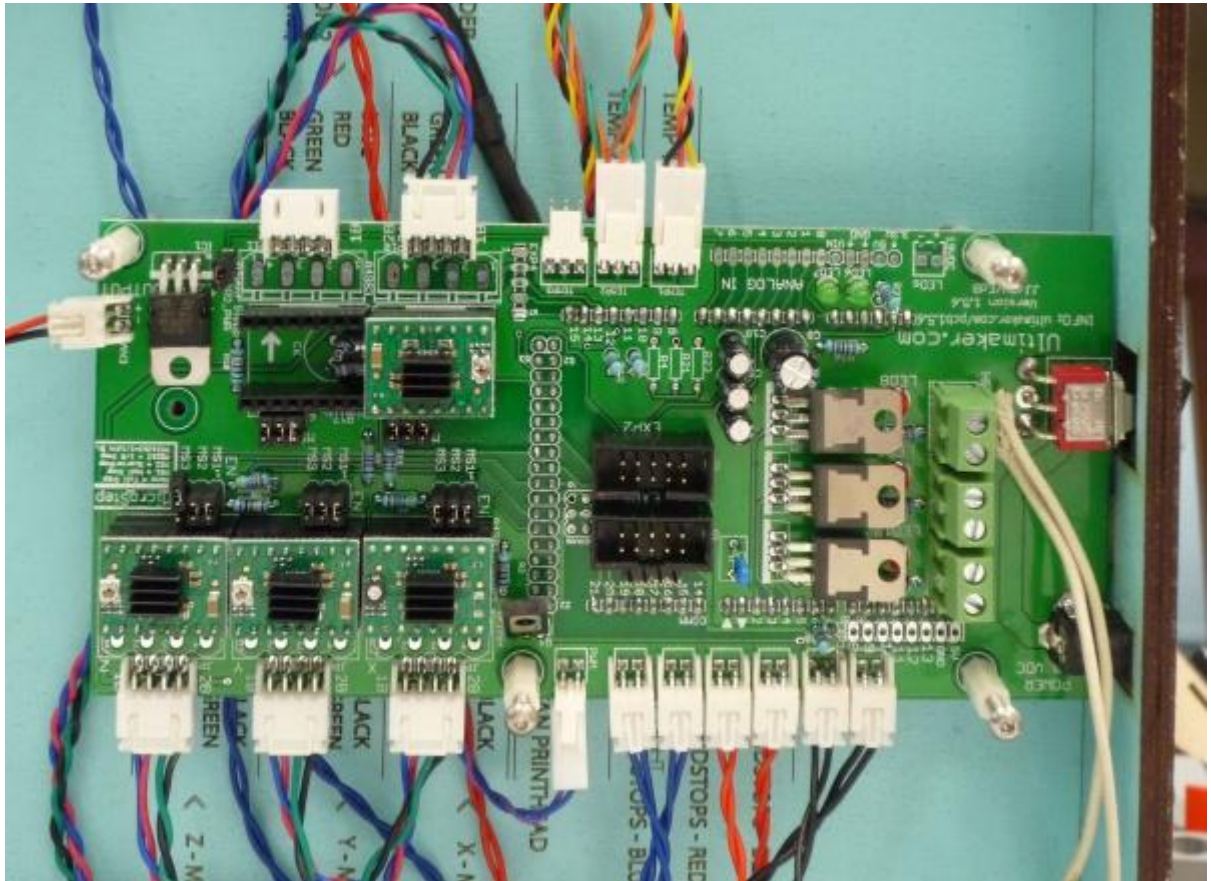
The Z-MOTOR is connected tot the BOTTOM of the machine and needs to be connected at the circuit board where is says Z-MOTOR.

The EXTRUDER-MOTOR is connected to the BACK (outside) the machine and needs to be connected at the circuit board where is says EXTRUDER-MOTOR.

3. *Optional is to connect a 24V led strip (some were supplied with the very first kits) directly the 19V of the power supply. Alternatively, if you want the LED's to blink*

while extruding, you can connect it in parallel with one of the extruder motor phase (output 1/2, or output 3/4 of extruder 1).

4. If you have a JoysMaker controller, now is a good time to assemble it and connect it to the electronics. This will save you some time later on, as you don't need to remove the cooling system again.
5. When your circuit board looks like the one shown below, you can safely mount cooling system as written in Step 3.



## 8.8 Step 8: Installing the electronics cooling system

### Needed in this step

Qty.	Description	Notes
4	Socket cap M3 bolts 10mm	Used for installing the electronics.

1. Insert the 10mm bolts into the white threaded spacers, but not all the way.
2. Place the cooling assembly over the bolts, guiding them through the larger holes.





3. Slide the part in place to lock it.

4. Insert the bolts slightly more so that they touch the wood.



## 8.9 Step 9: Strain relief



Picture by Bernhard

1. Wrap the black cable, bowden cable and the white cables of the heater together in transparent wire wrapping to get a tidy cable.
  2. At the bottom you should wrap the electronic cables together with the velcro strips.
  3. The cables inside the transparent wire wrapping should go through a strain relief at the extruder end.
- The black F-shaped part that is bolted on top of the extruder housing, can be used to wrap the thin wires through.



**This will ensure that if you pull the cable, it will not put strain on the crimped connections in the connector, but instead put the strain on the F-shaped part.**

## 8.10 Step 10: Checking and aligning the Z-homing switch



**This is the MOST important end-stop of the system. It is important that the starting height of your machine is about 0.1mm above the platform, and especially important that it doesn't start after digging INTO the platform.**

### **Start by leveling the bed.**

1. Turn the Z-lead screw until the the extruder head is almost touching the build-platform.
2. Move the printhead to the front left corner.
3. Turn the adjustment bolt up until it touches the platform.
4. Screw DOWN the front right of the platform until you can move the print head to the right side of the platform without scratching the platform.
5. Then turn it up slightly until it also touches the platform.
6. Repeat this process for the adjustment bolts in the back.

Your platform's plane should now be exactly parallel to the XY-plane. **Now it's time to adjust and TEST the Z-switch.**

1. The top Z-switch in the back (with black wires) is for homing the platform until the platform is elevated to the 'zero' position. Zero means, no distance between the platform and print-head. It should already be installed.
2. Loosen the bolts slightly so you can move it up and down.
3. Turn the lead screw to elevate the platform until the head almost touches the platform.
4. Now lower the endstop and fasten it slightly on one side, while still being able to



slide in the other slot. Sliding the 'free side' means that you're rotating the switch a little bit.

5. Rotate it until it the switch click in the closed position.
6. Then fasten the other side slightly. If it doesn't click yet, that's okay, just lower the other bolt of the switch until it clicks.
7. Check the Z-position when it clicks the switch to the closed position. Where it clicks open again is not as important, as long as it doesn't stay closed.
8. Fasten both bolts fully. They're allowed to sink into the wood slightly, the switch shouldn't move anymore.



**When you're using the control software for the first time, test the response to the limit switches, especially the Z-homing switch.**

## 8.11 Troubleshooting the mechanics

Please interact through the forums at [Ultimaker.com/community](https://ultimaker.com/community). Please also have a look at the [Troubleshooting the mechanics](#) page.

## 8.12 What's next?

Congratulations! You now have a complete 3D printer. Learn how to use your printer by starting with the Cura software setup:

## 9 Software setup guide

### 9.1 Setting up the JoysMaker 3D printing software

This guide will help you setup your printer. Cura is the JoysMaker supported piece of software. NetFabb is another option, it is a fast and professional slicer with many advanced features. Both Cura and NetFabb allow you to process a 3D model into a printable file, and printing this file directly on your machine (direct connection). Cura will automatically detect your machine and will work faster and produce better quality prints. You can process the file with Cura or NetFabb and then copy the file onto the SD card which goes into the [UltiController](#). You can then print the model without a connection between the PC and JoysMaker. In NetFabb, the direct connection will not always work, so the UltiController option is strongly recommended for printing in conjunction with NetFabb.

In this step we be installing the Cura and begin to use it.

#### 9.2 Contents

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[1 Setting up the JoysMaker 3D printing software](#)

[2 Download](#)

[3 Documentation](#)

[4 Using Cura](#)

[5 Preparing a model file for printing](#)

[6 Troubleshooting](#)

[7 Linux Dependencies](#)

[8 Guides in other languages](#)

[9 Advanced features](#)

[10 Questions or comments regarding this page? Let us and others](#)

[know!](#)



Category: Software

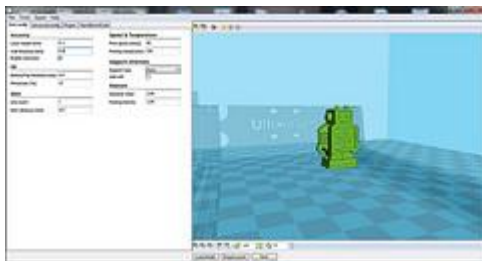
Cura is developed by Ultimaker to make 3D printing as easy and streamlined as possible. It includes everything you need to prepare a 3D file for printing and to print it. Cura is fully preconfigured to work on the Ultimaker. Cura comes with a friendly setup program that help you install the latest firmware as well as calibrate your printer. JoysMaker is compatible with Ultimaker.

### 9.3 Download

The latest version for Windows, Mac and Linux can always be found at the [Ultimaker software downloads page](#).

### 9.4 Documentation

Main documentation for Cura can be found at GitHub: [GitHub](#)



### 9.5 Using Cura

Installing Cura is very simple. Click the version required by the system you run, unpack it and you are ready to go.

### 9.6 Preparing a model file for printing

Now, I assume you have a 3D model you want to print. Otherwise, you can get one from [Thingiverse](#). Cura converts model files (such as .STL files) to read this file and convert it into GCode. GCode are the movement instructions for your printer. Use the "Load model" button to load an view your 3D model. Then use "Prepare print" button to start the creation of the GCode file. This will take a while,

and when the progress bar is done, you can go to the next step. You can then print through USB, or place your GCode file onto the SD card with the click of a button!



**You can print with lower temperatures than 230C, but temperatures between 210 to 230C are a good starting point. You can start lowering the temperature after printing with success. Note that lower temperatures could cause problems, especially at high printing speeds.**

## 9.7 Troubleshooting

Installing Cura on Linux has a few caveats. Check out [installing Cura on Linux](#). If Cura doesn't work for you, then goto the [Ultimaker Forums](#) for help.

## 9.8 Linux Dependencies

For an Ubuntu distribution, you will also need to install the following dependencies:

```
sudo apt-get install python-setuptools python-numpy  
python-scipy python-wxgtk2.8 python-wxtools wx2.8-i18n  
libwxgtk2.8-dev libgtk2.0-dev
```

You will also need to install python dependencies ([how to install pip](#)):

```
pip install PyOpenGL PyOpenGL_accelerate pyserial numpy
```

And one module not available via pip;

<https://github.com/GreatFruitOmsk/Power>

If you are on Ubuntu 12.04, you may need to add wx to the python path:

```
export  
PYTHONPATH="$PYTHONPATH":/usr/lib/python2.7/dist-packages/wx  
-2.8-gtk2-unicode
```

## 10 Troubleshooting

### 10.1 Problems by observation

#### 10.1.1 Printing in material A worked fine, now material B doesn't print well!

See the section on [Polymers](#) and "[Troubleshooting: Solving flow related problems](#)".

#### 10.1.2 Brown sludge forms on the extruder head

If your printer came with an [ABS Fix Kit](#) (a piece of ABS filament), running this through the extruder will seal up any small leaks around the printer head. If for some reason you did not get this kit, any piece of 3mm ABS filament will do.

#### 10.1.3 Plastic comes out of extruder head in a flowing state

If you turn the big extruder wheel manually, the plastic exiting the extruder head should form a thin line of plastic that hangs from the extruder head. If however the plastic does not form this thin line, but rather forms a droplet at the extruder head, you are heating the plastic too much.

Be careful. Too high temperatures can cause the plastic to burn and form a plug. In general, start at 215C for PLA plastic and 225 for ABS plastic.

#### 10.1.4 The extruder stops extruding

There are several possible causes for this:

- You are trying to extrude when the extruder is still cold. There is a pre-build function in Marlin that prevents cold extrusion. It could also be because of a failure. Please check the warning log.
- You're trying to extrude too much material in a small volume. Try to print a really thin walled object. If these objects work well, but a large infill doesn't, it shows you that the extrusion rate is too high.
- The temperature at which you're extruding material needs to be high enough. If you've just switched materials, e.g. from ABS to PLA, you need to extrude at the ABS temperatures to flush out the ABS. This may take quite some printing to get the last remains of ABS out of the extruder. Using temperatures that are normally suitable for PLA might jam the extruder if remains of ABS try to work their way through the nozzle. PLA can be printed at temperatures between 190 and 260 degrees C. At 250 degrees it will flow fairly easily. Above this temperature it might become too liquid and the nozzle might ooze too much.

- You're trying to extrude too fast. Try to lower the feed rate. PLA in general flows more easily than ABS. ABS will start to degrade when you heat it up too much, and might block the nozzle's orifice when it sits in the extruder for a long period of time. Heating it to a higher temperature in general allows you to print at the higher speeds.
- Possibly, liquid PLA is pushed upward in the extruder to a section where no heating is applied. When this solidifies, it causes the extruder to jam. Especially if there is a small gap between the PFA/PTFE tube and the brass part of the extruder, this will cause the plastic to be very hard to push through. Normally, the (low friction) bowden tube has such a low friction that you can still push out the solidified PLA with some force.
- When the extruder has jammed, the material-feed mechanism may continue to push material into the extruder. When that is blocked it will apply a large force on the bowden tube, causing it to come loose from the metal part of the extruder. After a while it will pull the connectors from the thermocouple board. Soon afterwards the extruder will overheat as the temperature feedback has been severed. Immediately disconnect the power when the bowden tube comes loose.

Apart from these hints, it's always good to heat up the extruder, and to try to push the filament in by hand. It should be possible to push it in with reasonable force. First see if the temperature you're setting it to is appropriate for the material that you're using. PLA becomes fairly liquid at around 250 degrees. Below this temperature it is still pretty viscous and becomes more difficult to extrude.

See also:

- [Solving flow related problems](#)
- [How to remove PLA when blocked and hack the PTFT cable](#)

### 10.1.5 The first layer doesn't stick!

This is a common problem because all [thermoplastics vary](#). Even if you're using PLA, one color of thermoplastic may stick perfectly while another color does not stick at all: this is because the colorants affect the melting point, also shift the recommended print temperatures.

If you have trouble getting the first layer to stick, you can do several things:

- Make sure the print head is almost touching the platform for the first layer. This helps because the plastic is really pushed into the texture of the blue tape. This will also help with the pressure build up before you print. Don't hesitate to do a small adjustment by turning the Z-lead screw by hand just after your print has started. If this works better, you can make this permanent by changing the height of the Z-limit switch at the back of the machine (the top one).

- Just when the print starts, you can turn the extruder-drive's gear a little to get increase the material flow for the first layer. This helps for the same reasons mentioned above. Don't worry, you will not damage the motor by pushing it through its steps, it will just skip a few steps which is totally harmless!
- If you're printing directly onto the acrylic platform, sanding and/or scratching the acrylic will help to create a stronger bond.
- Try raising your extrusion temp a few degrees, even bumping the print temp by 5 degrees or so can really make a difference.
- Ensure that the bed is level. If it isn't level, this will create a good bond in one place, but the head will be too high in the other.
- For the first layer, *during printing* you can increase the 'flow rate' through the Real Time Tuning feature (by clicking the icon with the sliders). Slide it back to 100% when the first layer has finished.
- Sometimes the tape is greasy, this makes it hard for the PLA to stick on it. Cleaning it with some rubbing alcohol removes the grease and makes the PLA stick easier.

#### 10.1.6 My 3D prints do not look good!

- [Analyzing your first print](#) (a great post by Florian on his blog)
- Check if the fan (near the print head) turns on after the first layer has printed. If you can turn it on with the control panel, it's wired up correctly. If not, check the wiring. Also check your Skeinforge profile's "Cool section". If an M107 code is in the G-Code, this means that the fan SHOULD turn on.

#### Problem: layers aren't stacked very well on top of each other

- Solution 1: make sure your long belts are tight enough (see this [instruction video](#)).
- Solution 2: check if the short belts are tight, if not, slide down the motor in its slots and re-tighten them. You probably need washers to tighten it all the way.
- Solution 3: if too much plastic is extruded, it will try to find its way out of the extruder where it shouldn't be. Lower the extrusion rate.
- Solution 4: if too little plastic is extruded it will take shortcuts, the following layers may not stick to the layer below, because parts of that layer aren't where they're supposed to be. Increase the extrusion rate.
- Solution 5: check if your object has enough time to cool before the next layer. If you print an object with a thin cross section very fast, it will not have



time to cool. Slow down your print speed. You can force a layer to always take a certain amount of time, this is done in the "Cool" section of your Skeinforge profile. Also, ensure that the "Turn fan on" checkbox is ticked there and that the fan indeed turns on!

**Problem: the object looks sparse, there are holes in them! (see picture on the right)**



A very sparse print

The problem is that too little plastic is extruded. This can have several causes, each cause requires a different approach to solve it.

The causes and solutions are discussed in: [Troubleshooting: Solving flow related problems](#).

## 10.2 Mechanical problems

### 10.2.1 X/Y axis

**The extruder head stops moving during a print, or doesn't move at all (even in manual mode). Also a stuttering or grinding noise can be heard from the stepper motors.**

This is caused by a stepper motor driver that is too cold or overheating. Try to tune the stepper motor driver to a more ideal setting. You can find a manual about the stepper motor driver in the [Electronics build guide](#).

**There is a lot of friction when I move the extruder head around by hand. What can I do?**





First, check if you accidentally used square nuts for the caps that hold the rods captive (on the inside of the frame).

When moving the head by hand, do it by pushing the wooden blocks in ends of the rods. Pushing directly on the print head assembly twists the bushings and causes them to jam. This might give the illusion that there is more friction than there actually is.

The important thing to keep in mind is that all angles need to be orthogonal (90 degrees), not 95 or 85 degrees... The best way to achieve that the crossing rods are orthogonal is to loosen pairs of pulleys. You don't need to open the jaws of the blocks where the timing belt passes through, this is too tedious and the same result is achieved by loosening the pulleys.

Usually it is easier to ensure they are orthogonal by putting an axis (X or Y) near its end, and to compare the distance between the blocks. For the X axis (left to right if you stand in front of the machine), it is important to keep both blocks at about the same distance.

Very rarely, it seems that it runs slightly more smoothly when it's not orthogonal, but both crossing rods have an odd angle but exactly to same extent. This would lead to slightly trapezoid prints which are no good for prints that need to be mechanically accurate. Perhaps it's good to loosen the bolts of the wooden extruder housing and tighten them with the extruder housing after it has been installed in the machine.

Don't grease the rods! All bearing in the JoysMakers are self-lubricating! Use the teflon-based grease ONLY for the Z spindle. That's where it belongs.



An example of barely touching outer line. Click on the picture to see more details and

annotations on the image.

**When a layer is printed, the perimeters and infill of the object do not or barely touch. How can I fix this?**



**Ensure that the motors have cooled down before you press on the motor, otherwise you risk getting burns.**

This could have a mechanical and a software cause. The software should ensure that the perimeter and infill overlap slightly. This part is about the mechanics: One thing that could cause this (a bit) would be too loosened motor timing belts (the two short belts). If the X axis has this problem, you'll see gaps at the left and right side between the perimeter and infill. If the Y axis has this problem, it will happen at the front and back of your print (when looking at the front of the machine). To fix this problem, loosen the four bolts, push the motor down firmly and hold it that way while fastening the motor bolts. Make sure you wait a while for the motors to cool down.

This problem can also be caused by loose belts, especially the short ones. For the long belts, see this [instruction video](#).

### 10.2.2 Z-axis

#### The object doesn't have the correct height

If the object is longer or shorter, the Z-axis may have too much friction.

- Observation A: The height is exactly twice as big/small
  - Check the jumper configuration correspond with the intended settings in the guide (for those with the 1.5 PCB version. If you don't have jumpers on your electronics, this isn't the problem).
- Observation B: sometimes the platform lowers less than it should
  - Solution 1: lubricate the leadscrew (along its entire operating length), if that doesn't help, [increase power to the z-motor](#).
  - Solution 2: If that doesn't help, see if the Z-axis is trying to move too quickly. You can set a limit in your Skeinforge profile (under Limits).
  - Solution 3: Check if the top end-stop is being triggered at random intervals by electromagnetic interference (EMI). How? If the problem is gone with the top Z-home limit-switch detached, it was EMI. Twist the wires or (still not enough?!) shield the wires if this is causing it.

---

## The object seems to have ripples in the Z-axis

The machine is depositing plastic, so it will always have ripples. However, there are several cases that can cause irregular behavior:

- If the printhead is not levelled out correctly, the print will deposit more on one side than the other, causing it to ripple or even warp prematurely.
- If the printhead is level but the print looks shakey, it can be caused by several problems:
  - The Z-axis rod may have bent during shipping.
  - The Z-axis rod is not correctly seated in the aluminium holder.
  - The print is warping while printing, or has come loose on several parts.

### 10.3 Electrical problems

---

#### Nothing happens when I toggle the ON switch

If your machine suffered a short circuit the power supply (PSU) might have shut down itself as safety measure. What to do: Disconnect the PSU from the **wall socket and the printer** this lets it reset. Reconnect and try the ON switch again.